ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXIII, No. 18.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK..... 281
The Effect of Freezing on Cement Mortars (illustrated) 282
Stand-Pipe Accidents and Failures (illustrated).. 285
The Tennessee River Improvement..... 291
Sewage Purification in America (with inset, illustrated) 292
Tests of Non-Conducting Pipe Coverings..... 294
A Heliotrope Flag for Engineers..... 295
Legal Electrical Units in the United States. 295
Standard Pile Trestle; Elkhart & Western R. R. 295
Legal Decisions of Interest to Engineers..... 296
BOOK REVIEWS..... 296
EDITORIAL NOTES..... 288
Award of Cross of Legion of Honor to the Chief Engineer of "La Gascogne"—Muscle Shoals Canal, Tennessee River Improvement—Effect of Freezing on Cement Mortar—The Jersey City Water Situation.
EDITORIAL.
The Location of the Nicaragua Canal..... 289
LETTERS TO THE EDITOR..... 289
Stand-Pipe Specifications—Pin-Connected Warren Trusses for Short-Span Bridges—Recent Paving Brick Tests: Correction.

Bids for the completion of the Brooklyn dry dock, on the annulled contract of John Gillies, were opened by the Navy Department on April 23. The Gillies contract, signed Nov. 17, 1892, called for the completion of the dock in 32 months for $462,619.18; and the Department had paid him $165,000. Of the original appropriation of $500,000 by Congress only $335,000 remains. The bids received for completion were as follows: Simpson Dry Dock Co., $465,566; J. B. Westerbrook, $409,068; Colin McLean, $377,000; Thomas and August Walsh, $370,000. The contract has been awarded to the lowest bidder.

A sewer contract, the estimates for which amount to over $200,000, is to be awarded by the Department of City Works, Brooklyn, N. Y., on May 6. The contract is for the construction of Section No. 2 of the main relief sewer in Greene Ave., this section extending from Lewis Ave. to Union St. Some particulars of this sewer were given in our issue of Dec. 6, 1894.

A bill to authorize the city of New York to expend $55,000,000 on the construction of a rapid transit system has been submitted to the mayor for his signature, and two public hearings on the bill were given at the city hall last week. Mr. Abram S. Hewitt spoke very strongly against the bill, claiming that the original amount of $50,000,000 allowed should not be exceeded. In his opinion one change would lead to another, and there was no knowing where the expenditures would stop, and the result would be that rapid transit would be indefinitely postponed. Mr. Seth Low and Mr. Alexander E. Orr, of the Rapid Transit Commission, spoke in favor of the bill.

The New York police census, just completed, gives a population of 1,849,866, or a gain of 139,151 since the previous police census of October, 1890. The U. S. census of 1890 credited New York with a population of 1,515,351, though these figures were discredited at the time and were considerably less than the police count for the same year. Mr. Charles G. Wilson, President of the Board of Health, certifies that he believes this last record to be "approximately correct."

Another Pennsylvania decision against a trolley railway is recorded. Judge Swartz has granted, on the suit of the Pennsylvania R. R. Co., an injunction restraining the Bridgeport Railroad Company from operating an electric railway on the public road between Bridgeport and Swedeland, in Chester County. The Bridgeport Company was chartered a few weeks ago under the general railroad law of 1868, after the operation of the trolley line had ceased under the recent decision of the Pennsylvania Supreme Court, with the charged intent to evade this decision. Judge Swartz decided that while, under its present charter, the company has the right of eminent domain, and the duty of carrying freight is imposed upon it, there is no evidence that it is not a street railway company, in construction, operation and purpose. It is without facilities for the transport or storage of freight, has no connection with other freight transporting companies, and to permit it to operate a constructed street railway under the new charter is to ignore entirely the well-defined distinction made between a street passenger railway and a steam railway in the Act of 1868.

The most serious railway accident of the week was a rear collision April 26 at Massillon, O., on the Cleveland, Lorain & Wheeling R. R. A freight train had been stopped on the track, and a flagman was sent back, but it is said he did not go far enough, and a following freight train ran into the rear of the first train. The caboose of the first train and the engine of the second were smashed.—A rear collision between the two sections of a parted freight train occurred on the Poughkeepsie Bridge April 29, the accident occurring on one of the east shore spans. Some of the cars were derailed.

The main belt flywheel at the power station of the Braintree, Randolph & Holbrook Electric Ry. at Braintree, Mass., burst April 22, the broken pieces breaking the belt wheel of the dynamo. One man was badly injured by the broken belt.

The Spanish warship "Reina Regente," which has been missing for some weeks, has been discovered lying in deep water between Tarifa and Trafalgar, on the Atlantic side of the Straits of Gibraltar. It is supposed she foundered during a heavy storm, but there is much discussion as to the vessel's seaworthiness. This was one of the warships which took part in the naval parade in New York harbor in 1892.

A section of the front or river wall of Mill No. 5 of the Lawrence Mfg. Co., at Lowell, Mass., gave way April 24 and fell into the river, leaving a gap about 30 ft. wide from top to bottom of the four-story building, and causing the floors to sag and machinery, shafting and steam pipes to be thrown out of position. About 150 employees were at work, but none were hurt. A raceway passed through this wall by an arch, and the collapse of the arch caused the fall of the wall above it.

The coping and iron rods for carrying the flashboards on the Amoskeag dam at Manchester, N. H., have been carried away for a distance of about 50 ft. The flashboards were about 2 ft. high at the time.

A reservoir dam at Bouzey, near Epinal, France, gave way in the early morning April 27, and the torrent of water caused considerable damage to villages below the reservoir, washed out parts of the railway, and covered farms and property with water and mud. The break is said to have been about 330 ft. wide. Between 100 and 150 lives were lost, and hundreds of sheep and cattle were drowned. Press reports give this as a masonry dam, 1,650 ft. long, 66 ft. high and 66 ft. wide at the base, founded on sandstone. It was commenced in 1879, completed in 1884, and strengthened in 1889, up till which time the reservoir had never been entirely filled. A correspondent states that this dam was straight, and was cracked by the contraction due to changes of temperature last winter. He also states that it is reported to have bulged about 3 ft. by the water pressure at the time. The failure may, therefore, probably be considered as due to the same causes as that of the failure of the Colombo reservoir wall, in Ceylon, discussed in our issues of Aug. 9 and Sept. 27, 1894.

Another fast railway run is reported, this time for a special train on the Delaware, Lackawanna & Western R. R., which ran from Hoboken to Buffalo, N. Y., on April 27, making the trip of 404 miles to East Buffalo in eight hours, or at the rate of 50½ miles per hour, including stops. The fastest parts of the trip were from Binghamton to Elmira, 57 miles, in 53 minutes (61.3 miles per hour), and between Bath and East Buffalo, 103 miles, in 103 minutes. The total distance of 197 miles from Binghamton to East Buffalo was made in 185 minutes, excluding stops, or at an average speed of 60.64 miles per hour.

A sidewheel steamer for passenger service between Buffalo, N. Y., and Cleveland, O., is being built by the Detroit Drydock Co., of Detroit, Mich., for the Cleveland & Buffalo Transit Co. The hull will be of open-hearth steel, specified to contain not more than 0.075% of phosphorus. The compound engine will be of the walking beam type, 12 ft. stroke, fitted with the Sickles cut-off, and there will be about 16 auxiliary engines, and there will be an electric light plant with a capacity of about 1,200 lamps. Steam will be supplied by six marine tubular boilers. The wheels will be of steel, with feathering buckets. A bow rudder will enable the ship to be steered easily down the Buffalo creek. There will be sleeping accommodation for about 600 passengers.

The common council of Detroit, Mich., has failed to make any appropriation for cleaning the streets and alleys, and the alleys are said to be in a disgraceful and unhealthy condition, but it is said that this will be provided for by enforcing a clause of the city charter requiring owners or occupants to clean half the width of the alley within 24 hours after having been notified by the police.

Mail cars are being run on the Germantown Division of the People's Traction Co., of Philadelphia, Pa. They are 16 ft. long in the body, and each is carried on a four-wheel truck. They are exclusively for mail service, and have drop boxes in which letters may be posted.

Aluminum plates, made by the Pittsburg Reduction Company, are to be used on the new American yacht "Defender," above the water line. As described in press accounts, these plates are 12 ft long, 5-16 in. thick and vary in width from 22 to 30 ins. They are said to have an alloy of 10% of copper, and are extremely smooth in finish. The plates of the "Defender" below the water line, where greater strength is required, will be made of manganese bronze, of the same thickness as the aluminum plates.

An electric locomotive with eight driving wheels has been built by the Baldwin Locomotive Works for the North American Co., which operates the property of the Oregon & Transcontinental Co. and extensive street railway and electric lighting interests in Milwaukee. This locomotive was designed by Sprague, Duncan & Hutchinson, of New York, and it is intended for special experimental work in handling heavy freight and for switching purposes. The wheels are 56 ins. diameter, the two middle pairs having blind tires, and all are connected by side rods. There are four motors of 250 HP. The total weight of the engine is about 130,000 lbs., equally distributed.

The detail of the accident at the Latchford lock on the Manchester Canal, lately commented upon by this journal, is thus given in "The Engineer," of London: On April 10 the steamer "Harold," of 600 tons burden and light, approached the Latchford lock. The upper gates were open and the intermediate gates were closed. The steamer was coming with undue speed, and an attempt was made to close the upper gates; but before this could be done the "Harold" struck and demolished the intermediate gates, dropped 16 ft. into the pond below and proceeded several hundred yards and through the open lower gates before she was stopped. The intermediate gates were destroyed before the upper gates were mitered and the rush of water drew the southerly leaf forward so that the head bent outward 5 ft. at the upper end of the miter-post. Tackles hastily applied prevented further injury, and the gates held against the 16 ft. head of water. One leaf of the intermediate gate was carried 100 ft. away, and the other was torn from its fastenings and completely wrecked. The masonry, however, was uninjured, and after the wreck was cleared away the upper gates were found to work better than was anticipated. By using the upper and lower gates only the canal was again opened to navigation in about four days. The speed of the "Harold" was estimated at 8 miles per hour, and was charged to some disarrangement of her machinery. The vessel suffered little damage, her stem and a few plates being bent. The accident is cited as bearing testimony to the wisdom of using intermediate gates in ship-canals, both for saving water and for additional security.

The Great Colombian Railway, for which a concession has been granted to Mr. S. B. McConnico, of New York, is to extend from the town of Girardot, on the Magdalena River, to the city of Bogota, the capital of Colombia, a distance of 93 miles. The concession includes the 25 miles of railway built and operated by the government from Girardot, and grants a subsidy of $16,000 per mile for all new road built, with a land grant of 125,000 acres, and the right to mortgage the entire road to the extent of $32,000 per mile. The work will be mostly side cutting, with no tunnels or expensive bridges, and the grades can be kept down to 3½%, although the difference in elevation between the river and the plains of Bogota is 7,500 ft. As far as Hospicio the line is over comparatively level ground, and from that point three surveys have been made by Mr. George A. Scheie, A. M. Inst. C. E., for the ascent of the Cordilleras. One route makes a loop to the southward, another makes a loop to the northward and connects with a government line from Bogota, while the third is more direct, and is proposed for the use of steep grades and the Abt rack-rail system. The northern route is the one considered the most favorable. At present all the traffic is carried by mules, and it is said that 20,000 mules are at present employed. Besides the local traffic, the line will form a link for the through traffic between Bogota and the port of Cartagena, by means of the steam navigation on the Magdalena River, and the Cartagena & Magdalena Ry., which was built by Mr. McConnico, and was described and illustrated in our issues of March 29, April 19 and June 14, 1894. The present Girardot Ry. is 25 miles long, and has a gage of 3 ft., but the gage of this and the new line may be 3 ft. 3⅜ ins.

THE EFFECT OF FREEZING ON CEMENT MORTARS.*

By Percy L. Barker, Milford, N. H., and Henry Allen Symonds, Hancock, N. H., Graduates in the Class of 1894, Thayer School of Civil Engineering, Dartmouth College.

The inadequate knowledge and conflicting opinions of engineers regarding the laying of masonry in freezing weather led to the investigations and experiments detailed in this paper.

Review of Former Experiments.—The following is a summary of former observations and experiments:

Mr. Wm. W. Maclay, C. E., in a paper before the Am. Soc C. E.,[1] gives the results of a series of experiments performed by him upon the effects of heating the ingredients of cement mortar and using the hot mortar at freezing temperatures. All the experiments were made with Burham cement. In order to get a comparison and show the exact effect of heating, two sets of briquettes were made. In one set the temperature of the cement paste averaged 40° F. and in the other 100° F. The sets were treated exactly alike and broken at the same time. The strength of the heated mixture was found to be only from 7% to 20% of that attained by the cold mixture. In the case of mortar made of 1 volume of cement to 2 of sand, the heated showed a strength only 30% of that reached by the cold mortar. Mr. Maclay concludes that the use of highly-heated materials in mortar greatly reduces its normal strength.

Gen. Q. A. Gillmore, in his work on Coignet Beton, states that: "The effect of freezing on newly made beton is to detach a thin scale from the exposed surface, but that "the injury does not extend into the mass of the material unless the frost be very intense. He adds: "When the temperature ranges but slightly below the freezing point during the day, work may be safely carried on if care be taken to cover the new material at night. After it has once set and had a few hours to harden neither severe frost nor alternate freezing and thawing has any effect upon it."

In the report of the Royal Testing Laboratory of Berlin of 1886, an account is given of a number of experiments made to ascertain the effect of frost upon the strength of Portland cement neat and mortar made of 5 parts of sand to 1 part cement. Two distinct series were made, the first one being exposed to freezing on and during the sixth day after mixing, while the second series of briquettes were treated as follows: (1) Allowed to set 24 hours in a warm room; (2) exposed 24 hours to freezing; (3) thawed four hours in a warm room, and (4) immersed until tested. Upon testing the specimens it was found that the effect of freezing varied with the quality of the cement; the loss of strength by freezing ranged from 2% to 22% in the cement, and from 3% to 24% in the mortar at seven days. After 28 days a deterioration was shown of from 2% to 12% in the neat cement and from 1% to 33% in the mortar. The best standard materials were used in the experiments. The use of pulverized slag from a blast furnace gave a greater loss of strength from freezing than in the former class of experiments.

Mr. J. Dutton Steele, in his note to the Am. Soc. C. E., says: "Cement mortar is not seriously impaired by being laid in frost, as its property of setting is simply held in suspense during the time it remains frozen."

Mr. Alfred Noble, in a paper before the Am. Soc. C. E.,[2] states that in the construction of a lock at the St. Mary's Falls Canal, the laying of masonry was discontinued about Oct. 20 of each year, on account of the frequent recurrence of freezing weather. On the last day of work done in 1877, mortars of Portland cement and of a good quality of American natural cement were used in adjoining portions of the wall. The same proportions of cement and sand, 1 to 1, were used in both classes of mortar. This masonry was laid during a light rain. The following spring the surface of the Portland cement mortar was sound, showing perfectly the marks of the rain drops. The natural cement mortar was disintegrated to a depth of 3 or 4 ins.

Mr. Noble also gives the results of some experiments upon Portland cement mortar with different proportions of salt in the mixing water. Two series of experiments were performed; the first indicating no marked effect when the amount of salt was increased, while the second series showed a less effect from frost as the amount of salt was increased. The conclusions to be drawn from the paper is that when it becomes obligatory to lay masonry[4] in freezing weather Portland cement mortar should be used.

In the winters of 1890-1891 and 1892-1893 a series of very instructive and valuable experiments were carried on by the Austrian Society of Engineers and Architects.[3] The experiments were undertaken to determine the kinds of mortar most suitable to be laid in freezing temperatures. They were brought about by the necessity of laying masonry in the winter in the construction of a theatre in Zurich, Switzerland. The opinions of experts who were consulted varied; one recommended Portland cement mixed with salt water, and the other, fat lime. Two classes of experiments were made with walls of rubble masonry and brick masonry, respectively. The dimensions were: 3 ft. 4 ins. long, 6 ft. 4 ins. high, and 10 ins. thick. The walls were constructed with lime, Roman cement, Portland cement, lime and Portland cement mixed, slag cement, and a patent frost-proof cement. Mortar was made of 1 part cementing material and 2 parts sand. Comparisons were made by the use of warm water, cold water and a 7% solution of salt in cold water, with the different cements. For further comparison parts of the walls were protected by timbering. The walls were torn to pieces in the early part of the succeeding summer, and results noted. Conclusions drawn from the ultimate conditions of the walls were as follows: (1) that lime as a cementing material is entirely unsuited for masonry construction in cold weather; (2) that Roman cement can be used with fairly good results in brick masonry, but is not suited to rubble-masonry construction in freezing temperatures; (3) that under freezing conditions Portland cement shows very little deterioration and results are especially good when the mortar is mixed with salt; (4) that mortar mixed with warm water shows about the same deterioration as when cold water is used, and (5) the frost-proof cement showed very little injury under the action of frost.

Mr. W. T. Hill, of Cornell University, performed a series of experiments in the winter of 1892-93.[4] The object of the experiments was to determine the effect of freezing 1 to 1 cement mortar 24 hours after mixing, then immersing it in water, which was kept at a temperature of 60° + F. until tested. Two different mixtures were used, one containing salt, in proportion by weight to mixing water of about 1 to 12, or 1% of weight of mortar. Comparison was made by mixing part of the cement in the test-room and part outdoors. Table I. gives a summary of the results in which the strengths given are, in each case, the average of four briquettes tested.

A question might be raised as to the value of these results, not supplemented by further experiments, to the practical engineer, for the conditions of frozen mortar in water of as high a temperature as that used in the experiments, for this purpose, is never approximated in actual construction.

A common practice is the use of salt in the mixing water of cement mortar which is to be exposed, before setting, to the action of frost. Mortar laid in the construction of a masonry dam in winter, on the Croton River, where salt was used, gave perfectly satisfactory results.[5] One pound of rock salt was dissolved in 18 gallons of water (about 1-150 by weight), at 32° F., and for each 3° lower temperature three ounces of salt additional was used.

Mr. J. F. Wallace used a brine of 8% salt in the mortar laid during cold weather in the construction of the Sibley bridge over the Mississippi River.[6] The masonry showed no signs of injury from the low temperatures to which it was exposed.

An examination of these data leads to the following conclusions: (1) heating the ingredients of cement mortar to be used in low temperatures is of no benefit and probably injurious; (2) that the freezing of Rosendale cement mortar while it is setting causes a disintegration of the exposed surface; (3) by inspection, Portland cement seldom shows any effect from being frozen; (4) that salt is generally beneficial in assisting the mortar to resist the action of frost; (5) that a great number of points regarding the freezing of cement mortar have received no study otherwise than by superficial examination.

It has been the object of the writers to carry through a system of actual tests in an endeavor to determine more exactly the amount of injury done to cement mortars under various conditions. Perfect comparisons can hardly be made because of the irregular fluctuations of temperature. That conclusions may be more accurately drawn in a study of the tables presented, a curve representing the variations of temperature during the whole time the experiments were carried on is given.

Apparatus and Method of Conducting Tests.—The transverse system of testing was adopted for the main part of the experiments for the following reasons: (1) because of the larger per cent. of good breaks; (2) the rapidity with which the tests may be performed, as represented by Messrs. Abbott and Morrison, in their paper (Engineering News, Dec. 14, 1893) upon the subject; (3) because the shape of the sides of the prisms allowed pressure to be applied with greater facility than would be possible with the tensile specimens made in bri-

TABLE I.—Results of Tests Made at Cornell University to Determine the Effect of Freezing Upon Cement Mortars.

Cement.	Age in weeks.	Mixed in test-room. Fresh water. Not frozen.	Mixed in test-room. Fresh water. Frozen.	Mixed in test-room. Salt water. Not frozen.	Mixed in test-room. Salt water. Frozen.	Mixed out-doors. Fresh water. Not frozen.	Mixed out-doors. Fresh water. Frozen.	Mixed out-doors. Salt water. Not frozen.	Mixed out-doors. Salt water. Frozen.
		Tensile strength, lbs. per sq. in.							
Improved Union	1	156	126	113	104	76	57	113	111
" "	13	300	277	238	235	212	138	149	100
Hoffman	1	55	57	88	45	72	58	103	62
"	13	215	164	180	194	270	209	233	220
Saylor	1	258	225	235	203	256	226	179	225
Am. Portland	13	423	447	384	335	428	406	319	398
Milwaukee	1	54	42	73	40	..	..	..	..
"	13	192	167	257	208	..	..	..	..

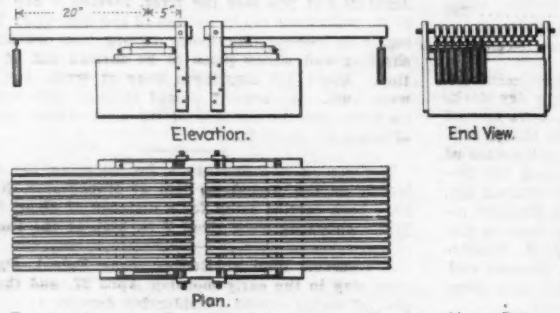

Fig. 1. General Details of Apparatus Used to Keep Prisms under Compression during Setting.

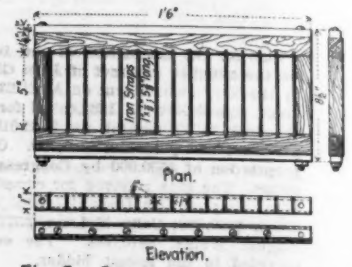

Fig. 2. Details of Molds for Making Prisms for Transverse Tests.

* The second and third prizes in Engineering News Thesis Competition for 1894 were divided equally between this paper and the paper on "Comparative Tests of Building Stones," published in the issue of March 28, 1895.

[1] Trans. Am. Soc. C. E. Vol. VI., 1877.
[2] Trans. Am. Soc. C. E., Vol. XVI., 1887.
[3] Engineering News, Vol. XXXI., 1894. Eng. Record, Vol. XXIX., 1894.
[4] Trans. Association of Engineers, Cornell University, 1893.
[5] Trans. Am. Soc. C. E., Vol. III., 1875. Paper by J. J. R. Croes.
[6] Trans. Am. Soc. C. E., Vol. XXI., 1889.

quette form, and thus one of the conditions of practice was more nearly realized.

It was assumed that an ordinary course of masonry of 18 ins. depth would be applied to the green mortar. This gives a pressure upon the mortar of about 2 lbs. per sq. in. To realize this condition, in the experiments a pressure of 10 lbs. per prism was applied.

Various methods of bringing this pressure upon the prisms were tried, but found unsatisfactory until a system of levers was arranged. Fig. 1 gives views of the machine employed, showing the arrangement of the molds under the levers. In the end view, part only of the weights are shown. The leverage was as given in the figure (5 to 1), consequently 2-lb. weights were used. The pressure was transmitted through a screw upon the center of a block of wood which exactly covered the top of the prism. A strip of tin was used between the block and the prism to prevent absorption of the water from the prism by the wood.

The molds used were "side filling" and are shown in Fig. 2. The sides were made of well-seasoned maple heavily ironed to prevent warping. Two styles of molds were used; one had a thin strip of sheet steel to separate the prisms; in the other, the more satisfactory, a strip of wood ½ in. thick was used. They were open at the top and bottom, but when in use the mold was placed upon a board ironed to prevent warping and having a plane surface. A piece of sheet-tin was placed between the mold and the board to prevent any absorption of water from the prisms. The testing machine was similar to the one used by Messrs. Abbott and Morrison (Engineering News, Dec. 14, 1893). Each prism was broken twice, first at the 4-in. span, then the longer end at the 2½-in. span. The load was applied to the prism at the rate of 140 lbs. per minute.

TABLE II.—Showing Effect of Freezing upon Newark Cement Prisms, Gaged with Salt, One Part; Water, Six Parts.

Age, days.	4 ins. span. Not frozen. No prisms tested.	Average, lbs.	R. ±	4 ins. span. Frozen. No prisms tested.	Average, lbs.	R. ±	2½ ins. span. Not frozen. No prisms tested.	Average, lbs.	R. ±	2½ ins. span. Frozen. No prisms tested.	Average, lbs.	R. ±
Neat cement mortar												
7-12	3	23	1.03	3	19	0.67	3	37	2.00	3	34	1.26
28	3	40	1.26	3	24	0.78	3	67	2.71	3	42	2.01
60	4	57	2.67	4	51	0.83	4	97	4.91	4	74	2.54
90	4	79	2.56	4	81	4.00	3	148	6.05	4	143	7.21
1 cement, 1 sand mortar.												
7-12	7	12	0.53	6	9	0.69	7	17	0.88	5	14	0.54
28	13	25	0.72	12	11	0.30	10	43	1.35	11	18	0.77
60	7	39	1.90	6	35	1.17	7	58	5.55	7	54	2.20
90	11	33	0.94	5	33	1.10	11	54	1.79	6	54	1.26
1 cement, 2 sand mortar.												
7-12	7	6	0.31	6	3	0.21	5	11	0.83	3	6	0.48
28	6	11	0.74	7	6	0.27	5	18	0.98	6	10	0.73
60	14	30	1.68	12	24	0.80	14	44	2.07	12	40	2.14
90	12	28	2.58	13	50	1.55	14	44	3.82	5	82	3.72

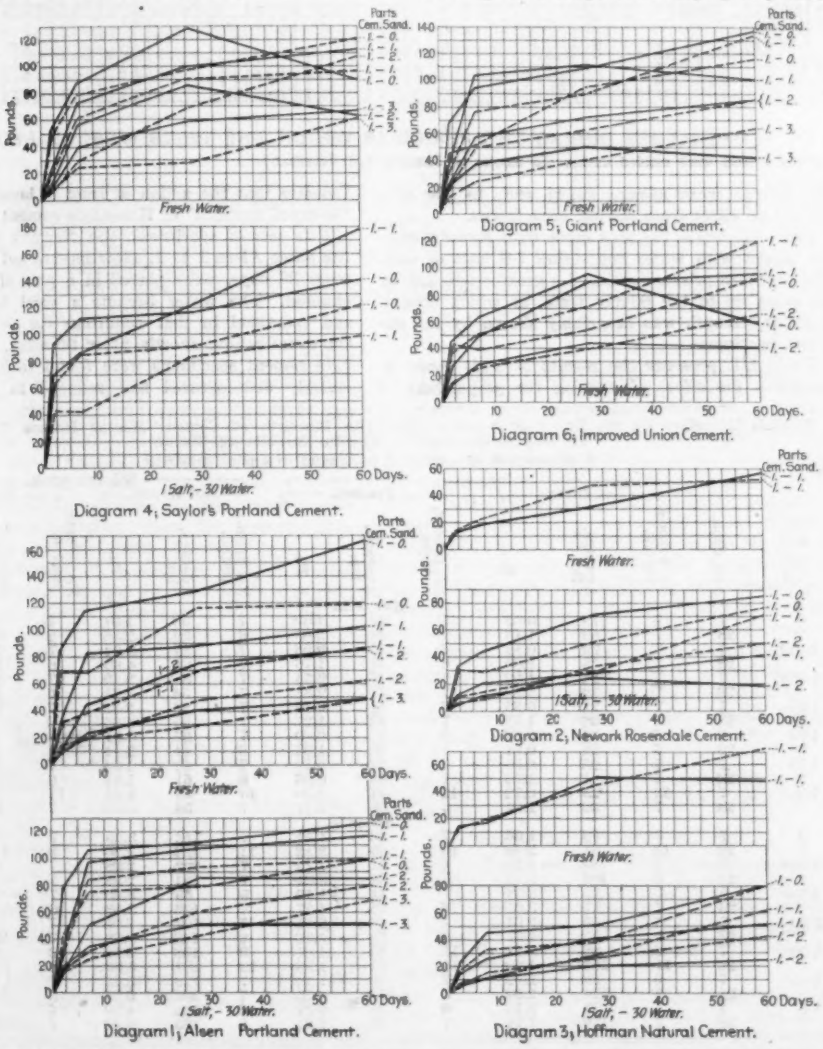

FIG. 3. DIAGRAMS SHOWING THE EFFECT OF FREEZING UPON THE STRENGTH OF PORTLAND AND NATURAL CEMENT MORTARS,

(The dotted lines indicate the prisms frozen.)

All mortar was mixed in the test-room, which was kept at a temperature varying very little from 50° F. The process of making the prisms was as follows: The cement and sand (or quartz) were thoroughly mixed dry, then water was added until the mixture had a consistency slightly stiffer than mortar as commonly mixed by masons. When thoroughly mixed the mortar was worked into the molds with small wooden bars and then lightly tamped, one of the molds having been exposed until it had attained the outside temperature. Precaution was used to get the mortar pressed into the molds with a uniform degree of solidity. A short series of experiments was performed to determine for each of the writers his personal equation, but no difference was noted. In all direct comparisons the same time was used in filling the molds. When filled, the cold mold was immediately exposed to the outside air in one of the pressure machines, while the other was placed in a pressure machine in the test-room. All sides of the prism were covered as in actual masonry. When the mortar had become thoroughly set the prisms were taken from the molds, those inside laid upon shelves in the test-room and the exposed prisms placed upon boards on the north side of the building, and covered enough to prevent the direct action of rain or snow upon them except at the ends, which were allowed to come to the edge of the covering and represent the exposed joints of actual masonry. The covering seemed to have little effect to obstruct the action of the frost and the specimens appeared frozen when the temperature was slightly below 32° F.

In the majority of the experiments, the exposed specimens were brought into the test-room one day before testing and placed upon screens, which allowed the entire surface of the specimen free access to the air. The regular tests were made at 2, 7, 28 and 60 days.

In order to establish a link between the experiments as performed with the transverse system of tests and the older system of tensile tests, a few sets of briquettes were made and treated in exactly the same way as the prisms, except that no pressure was applied to the briquettes.

The cement used consisted of six brands, viz., Newark, Hoffman, Improved Union, Alsen, Saylor's American Portland, Giant Portland. The sand used was not of the best quality, as it contained, before sifting, considerable dust. It was sharp and passed a sieve of 400 meshes per sq. in. (No. 28 wire), and was retained on a sieve of 900 meshes per sq. in. (No. 31 wire), this being the fineness recommended by the Am. Soc. C. E. committee.

The results of the various tests are shown in the accompanying tables and diagrams. In all of these tables the columns marked R° contains the "Probable error" of the arithmetical mean and is obtained by the formula

$$R_o = 0.6745 \sqrt{\frac{\Sigma\ v^2}{n\ (n-1)}},$$

in which

R_o = probable error of the arithmetical mean;

v = the difference between each observation and arithmetical mean;

n = number of independent observations. (Merriman's "Least Squares.")

(The diagrams, Fig. 3, show graphically the results given in detail in the principal table given by the authors, but which we omit on account of its great size. This table contained the results of nearly 3,500 tests, 1,911 of which were made with fresh water and the remainder with salt water containing 1 part of salt to 30 parts of water.—Ed.)

As preliminary experiments, a few neat Rosendale cement specimens, mixed with fresh water, were exposed to extremely low temperatures in the latter part of December. Upon examination at the end of two weeks, they were found to be disintegrated to about ⅛ their thickness. This was accepted as conclusive evidence that Rosendale cement, mixed with fresh water, was entirely unsuited for use in freezing weather, and no more experiments were performed in this direction at that time. Later in the winter, the writer's attention was accidentally called to the remarkable action of Rosendale cement mortars mixed with fresh water and allowed to freeze. It was often found that specimens which had been disintegrated to the depth of ⅛ in. while ex-

posed would show an "internal strength"* in excess of the strength of the unfrozen specimens. There was not then time to make a complete series of experiments of this class but the first 15 sets given are at least suggestive. The Improved Union, which is not strictly a Rosendale cement, shows equally interesting results.

In a few cases of Portland cements when frozen showed strength equal to or in excess of that of the unfrozen, but generally a marked decrease of strength is noted. A greater disintegration appeared to occur in the Rosendale cement when the prisms were exposed to an extremely low temperature than when exposed at a temperature not over 5° or 6° below the freezing point, but the "internal strength" does not seem to follow this law. In no case did the Portland cement specimens show the slightest surface disintegration. The latter fact is also true of the Improved Union. The details of the action can be studied by comparing the curves (Fig. 3) and the temperature curves (Fig. 4).

Diagram 2, Fig. 3, shows that when salt 1 water 30 is used, Newark neat is injured by freezing. The 1 to 1 and 1 to 2 mortars show a decrease of strength of the frozen prism for the 2 and 7-day tests, but an increase at 28 and 60 days. The corners and ends of the exposed prisms scaled badly. The Hoffman cement, Diagram 3, Fig. 3, was injured by freezing in all cases, excepting the 60-day test neat and the 1 to 2 mortar. The latter showed an increase of strength in all the tests by being frozen.

The Portlands generally show a decrease of strength in the exposed specimens, but the edges of the prisms were always sharp and, to the eye, showed no effect from having been frozen.

Table II. details the tests made with Newark cement mixed with water containing 1-6 part of salt. The unfrozen prisms developed a greater strength in all cases up to the 60-day tests, at which time a superior strength was invariably shown by the exposed specimens.

Table III. presents the results of tests made to ascertain the effect of varying the proportions of salt in the mixing water from fresh water to 1 part salt to 6 parts of water. Two cements, Newark and Alsen, only were used and two ages for testing, 7 and 28 days. The Rosendale was strongest with fresh water, showing an increase of strength by being exposed, except the case of salt 1 water 60, and salt 1 water 6, but there seems to be no regular increase or decrease of the effect of freezing by changing the proportions of salt. The Portland cement was injured by being frozen, but the injury decreases as the proportion of salt in the water increases, the fresh water exposed prisms being only 73% as strong as the unexposed and increasing to 93% in the case of salt 1 to water 15. In the case of salt 1 water 6 there is a great deterioration shown by the frozen specimens they being only 63% as strong as the unfrozen. It is also noticed that the maximum absolute strength is attained when salt 1 water 15 is used.

Table IV. gives the results of tests made to ascertain the effect of freezing cement mortar after having set 2, 10, 30 and 50 days in the test-room and then frozen. The prisms were brought into the test-room and tested at 60 days. The general results show that the strength increases as the number of days that the prisms are exposed to freezing increases, within the limits of the experiments.

Table V. is compiled from tests made to determine the action of mortar after having been frozen different lengths of time, and then brought into the test-room and tested at 28 and 60 days, respectively. The results, to a certain extent, corroborate the deductions to Table IV. Although not conclusive, they indicate that the action of frost is beneficial to the "internal strength" of Rosendale cement mortar.

Two sets of specimens, one Newark 1 to 2, and the other Alsen 1 to 1, after having set in the test-room 28 days, were placed in a pan of water and exposed. The water became a solid block of ice and remained in that condition for several days. On examination, shortly after thawing, the Rosendale cement specimens were found to have become entirely disintegrated and reduced to a mass of soft mud and scales. The Portland specimens, however, showed no signs of injury, the corners being as sharp as when first exposed. There was found to have been a loss of internal strength of, not over, 1-5th when the prisms were tested a few days after having become thawed. An exactly similar case to this was noted by Mr. Geo. S. Morison, M. Am. Soc. C. E. A pail of water, in which specimens of Rosendale and Portland cement were immersed, was exposed to freezing. The water became solid to the bottom. Upon thawing the ice the Rosendale specimens were found to have been reduced to mud, while the Portland specimens showed no injury.

Examination by the writers, of Rosendale cement mortar laid around the waste-way of the reservoir of the Hanover Water-Works gave another striking example of this action. The mortar was laid late in the fall and water stood around and upon it, more or less, during the winter. When examined in the spring the upper layer was found to

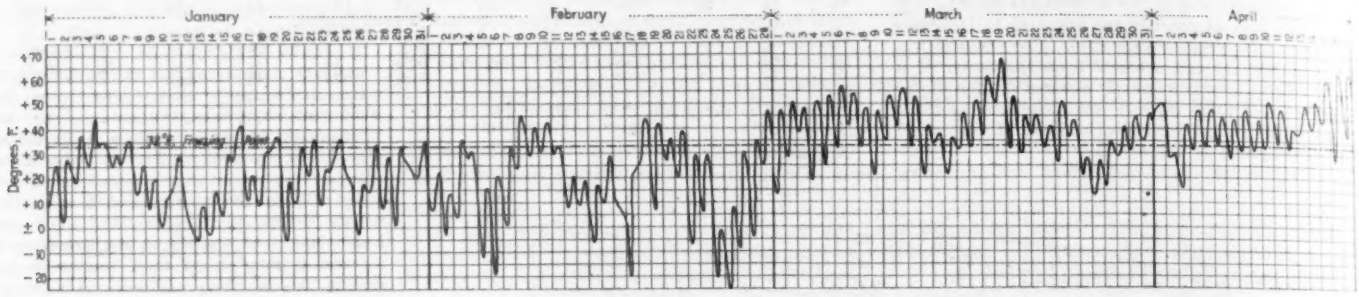

FIG. 4. DIAGRAM SHOWIMG THE VARIATION OF TEMPERATURE DURING THE PERIOD IN WHICH THE TESTS WERE IN PROGRESS.
(Practically all of the Prisms were molded during the months of January and February.)

TABLE IV.—Showing the Effect of Freezing After Setting Upon the Strength of 1 Cement 1 Sand Prisms Broken at 60 Days:

Age when exposed.	Prop. salt in water.	4 ins. span. No. prisms tested.	4 ins. span. Average, lbs.	2½ ins. span. No. prisms tested.	2½ ins. span. Average, lbs.
		Newark.			
2	1-30	7	78	7	118
10	...	3	63	4	114
30	...	7	71	7	109
50	...	7	56	6	87
2	0	6	70	7	106
10	...	7	65	7	100
30	...	7	51	6	70
50	...	6	44	7	66
2	0	6	39	7	59
10	...	7	47	6	62
30	...	7	57	4	83
50	...	7	41	7	58
		Improved Union.			
2	0	6	111	6	186
10	...	5	80	4	152
30	...	7	113	7	177
50	...	7	98	7	155
2	0	6	104	7	166
10	...	6	86	7	136
30	...	6	114	7	230
50	...	7	100	7	155
		Giant Portland.			
2	0	7	145	7	225
10	...	5	120	5	209
30	...	7	136	7	214
50	...	6	129	6	171

TABLE V.—Showing Strength of 1 Cement 1 Sand Mortar Frozen for Different Lengths of Time.

Exposed.	4 ins. span. No. prisms tested.	4 ins. span. Average, lbs.	2½ ins. span. No. prisms tested.	2½ ins. span. Average, lbs.
	Tested at 60 days. Newark.			
1	6	32	6	50
6	7	43	6	67
27	7	54	4	89
54	7	70	6	109
59	11	61	11	90
	Alsen's.			
1	7	94	7	134
6	7	104	5	152
27	7	98	6	146
59	7	139	6	190
54	7	128	7	194
59	7	124	7	193
	Tested at 28 days. Union.			
15	6	85	6	145
24	7	96	7	149
	Giant.			
15	7	104	6	172
24	7	99	6	161

TABLE III.—Showing the Effect of Freezing Upon the Strength of Cement Mortar Prisms Gaged with Varying Proportions of Salt in the Mixing Water.
(Composition of mortar, 1 part sand to 1 part cement.)

Prop. salt in water.	Age, days.	4 ins. span. Not frozen. No. prisms, tested.	Average, lbs.	±	4 ins. span. Frozen. No. prisms, tested.	Average, lbs.	±	2½ ins. span. Not frozen. No. prisms, tested.	Average, lbs.	±	2½ ins. span. Frozen. No. prisms, tested.	Average, lbs.	±
						New ark.							
0	7	7	19	0.32	7	23	1.59	7	30	1.91	7	42	1.72
"	28	7	32	1.73	7	48	2.88	6	50	2.45	2	87	0.33
1-150	7	7	22	0.82	7	15	0.53	7	30	2.32	7	23	0.55
"	28	7	35	1.60	6	37	1.76	7	61	4.66	6	58	3.15
1-100	7	7	24	1.02	7	17	0.54	7	35	2.40	7	26	0.74
"	28	7	38	2.30	7	41	2.32	7	54	1.75	6	71	4.52
1-60	7	7	21	0.85	6	15	0.48	7	36	2.32	7	20	0.57
"	28	7	36	1.81	7	33	1.27	7	55	3.35	6	51	1.66
1-30	7	7	21	0.86	7	15	0.69	7	36	0.84	6	23	1.28
"	28	6	28	0.91	7	29	1.04	6	44	2.14	7	48	2.78
1-15	7	7	25	0.54	7	18	0.39	7	43	1.94	7	32	2.12
"	28	7	41	1.76	7	50	0.86	6	61	1.34	6	71	2.16
1-6	7	13	25	0.72	12	11	0.30	10	43	1.35	11	18	0.77
"	28	7	39	1.91	6	35	1.17	7	58	5.55	7	54	2.20
						Alsen's.							
0	7	7	83	1.96	7	38	1.41	7	112	3.55	7	58	2.92
"	28	13	88	2.40	10	69	3.82	11	122	4.30	9	100	3.82
1-150	7	7	83	3.24	7	51	1.72	7	122	2.08	7	88	3.53
"	28	6	103	3.11	7	81	3.24	7	154	2.32	7	103	3.85
1-100	7	7	66	3.38	7	41	1.19	5	88	5.20	7	58	1.55
"	28	7	87	3.67	6	71	4.27	7	133	2.98	6	106	7.49
1-60	7	6	65	2.01	4	48	2.05	7	107	2.96	7	72	2.74
"	28	6	95	4.47	6	78	3.88	6	148	8.68	7	126	4.65
1-30	7	8	98	2.41	11	85	1.61	9	158	3.56	10	135	3.71
"	28	11	108	4.20	14	94	1.98	13	164	5.90	13	152	2.71
1-15	7	6	88	2.42	7	46	1.14	7	128	3.22	7	70	1.64
"	28	7	124	2.94	6	116	4.25	7	203	6.38	8	198	6.92
1-6	7	7	79	2.16	6	28	0.91	6	122	4.00	7	49	1.54
"	28	7	116	1.11	7	74	2.21	5	183	6.46	7	138	3.96

* To meet the case of those specimens which became disintegrated by being frozen, the term "Internal strength" is used in this paper to denote the strength of the reduced section.

be little more than a mass of dust and scales. Inspection of the same brand of cement (Hoffman) laid in the masonry of the gate-house of the same reservoir during cold weather, showed disintegration to about ¼ in. depth, but seemed in good condition beneath.

Examination was also made of the mortar used in the masonry of large paper mills at Olcott Falls, Vt. Various mortars were employed on different parts of the works as follows: Portland cement mixed with from 1 cement to 2 sand to 1 cement to 7 sand by volume, Rosendale was used with the same proportions of sand as the Portland. In the brick masonry an excellent quality of gray lime was used alone in the mortar and also mixed with Portland cement. The masonry was constructed in cold weather, a small amount being laid when the temperature ranged as low as 35° below zero. The Portland cement mortar was in excellent condition. The Rosendale cement mortar had scaled to some extent, especially where exposed to the extremely low temperature before setting. At a few points the mortar was found to be softened into the body of the masonry, but was generally hard below the first ½ in. The lime when mixed with Portland cement showed not the slightest injury from frost; when used alone in the mortar it appeared to act in a similar way to the Rosendale cement. For the information obtained and assistance in carrying on the examination, at these works the writers are indebted to Mr. Goss, Engineer-in-Charge for the Olcott Falls Paper Co., under whose superintendence the masonry construction has been carried on.

Conclusions from Tests.—In reviewing the data obtained, which include 6,150 separate tests (given) and over 1,000 auxiliary tests (not given), certain general conclusions are drawn:

(1) Portland cement mortar suffers no surface disintegration under any condition of freezing, but the strength is injured, in a majority of the cases, and sometimes as much as 40%.

(2) Rosendale cement is disintegrated upon the surface when exposed to frost while setting, the amount of injury depending to a certain extent upon the number of degrees of the exposure below the freezing point. Extremely low temperatures produce a greater effect upon the cement than temperatures near the freezing point.

(3) The cohesion of Rosendale cement mortar may be entirely destroyed by immersion in water, which becomes frozen around it.

(4) In the case of Rosendale cement mortar an increase of strength appears to be acquired under the conditions which it passes through while frozen.

(5) Salt used in the mixing water, in proportions varying around 1 to 15, assists the Rosendale cement to resist the disintegrating action of frost to the greatest advantage, but appears to have an injurious effect on the strength.

(6) The Improved Union, a mixture of Portland cement and natural rock cement, gives eminently satisfactory results. It shows the property of Portland cement as allowing no surface disintegration, and gives the characteristic of Rosendale cement in attaining an excess of strength under frost.

The results of the experiments and observations also suggest:

(1) That Portland cement mortar is injured relatively less by freezing as the ratio of cement to sand decreases.

(2) That Portland cement mortars are injured relatively less by the action of frost as the ratio of the salt in the mixing water increases to as high as 1 to 15.

(3) Lime, if of the proper quality, may be used with fairly good results in brick masonry if kept constantly frozen for some time after laying, but is ruined by alternate freezing and thawing.

It is hoped that this paper may be of practical value to engineers as establishing one more link in the chain of evidence relating to the principles governing the action of cements and cement mortars used in cold weather, and as suggesting principles to be further studied by future experimenters. In view of the results brought out by the tests, the following specifications for laying masonry in freezing weather are offered:

(1) The surface of the stone shall be free from ice and water, and shall not be heated above 50° F.

(2) If Portland cement is used, salt shall be used in the mixing water in the proportion of 1 part salt to 15 parts water by weight.

(3) The mixing shall be done at a temperature not exceeding 50° F. and not below 35° F.

(4) All joints shall be pointed with Portland cement mortar or with a mixed cement mortar of Portland and natural cement, if approved by the engineer.

(5) In no case shall Rosendale cement mortar be used where ice can form in contact with it.

STAND-PIPE ACCIDENTS AND FAILURES.

(Concluded from p. 271.)

Thibodaux, La., March 29, 1895.

On March 29, 1895, the 12 × 115-ft. steel stand-pipe at Thibodaux, La., while being filled for the first time, was observed to be settling unequally when about two-thirds full. It was emptied immediately for the purpose of investigating the cause of the trouble. The results of the investigation have not been learned.*

The thickness of the plates ranged from ⅝ in. at the base to ⅜ in. at the top of the stand-pipe. The foundation consisted of concrete and brickwork 8 ft. in thickness.

References.—New Orleans (La.), "Times-Democrat," March 27, 30, 1895.

Newport, Ark., July 9, 1894.

On July 9, 1894, the elevated wooden tank of the Newport (Ark) Water Co. fell to the ground, a total wreck. This tank was a duplicate of that which failed at Newport by the bursting of a hoop in May, 1887, as described in the original record. The diameter of the tank was 24 ft., and the staves were 20 ft. long by 3 ins. thick. The hoops were 20 in number, ranging from 3½ to 7 ins. wide, and having a thickness of 3-16 in. throughout. The diameter of the draw-bolts varied from ⅞ to 1¼ ins. No information as to the supporting tower is given, except that its height was 100 ft. and that it was built of timber.

The cause of the accident is not stated, but there is little doubt that it was due to the deterioration of the supporting frame. Early in 1893 the necessity of renewing or reinforcing the frame was recognized, and about a year previous to the failure a proposal to replace the wooden frame by a steel trestle tower, with the view to a subsequent renewal of the tank, when required, was received and seriously considered. It seems, however, that the water company, for some reason, deferred action in the matter too long, resulting in the serious consequences above recorded. It is stated that the third structure will consist of a steel tank of the same diameter and height as the former wooden tanks, and that the support will be a brick tower 100 ft. high.

References.—The Little Rock (Ark.) Gazette (Nov. 19, 1894). Correspondence (in 1893) with the Newport Water Co.

Salem, So. Dak., July 13, 1894.

A 16 × 24-ft. elevated wooden tank, connected with the water-works at Salem, So. Dak., failed on July 13, 1894. The following particulars regarding the tank and its failure were contributed by Mr. M. A. Blackburn, Engineer and Superintendent:

The foundation consisted of six masonry piers, each 11 ft. long, 18 ins. thick at the top, 3 ft. thick at the bottom, and 3 ft. deep. On these piers were laid 12 × 14-in. timbers 10 ft. in length, upon which stood twelve 12 × 12-in. vertical posts 20 ft. high. These were braced by 6-in. timbers, and tied by ⅝-in. iron rods. The posts were capped by 12 × 12-in. timbers, two 28 ft. and two 16 ft. in length, which in turn supported 2 × 14-in. joists, 12 ins. c. to c. The joists were not bridged, but were doubled beneath the central part of the tank. It was these joists that crushed and lopped over, causing the hoops of the tank to burst. A double floor of 1-in. boards was nailed to the joists, and upon this floor 4 × 6-in. "chime-posts" were placed to support the tank bottom. As the stone foundation, trestle-tower and cap timbers were level and plumb after the wreck, it is hardly possible that any defect in those respects caused the trouble. The tank was a regular 16 × 24-ft. structure.

Two eye-witnesses, one the assistant engineer, say they heard a noise as though some one was pounding on the hoops. On looking up they saw the tank settling to one side slightly. It then settled down, and at the same instant the hoops began bursting from the bottom and ripped upwards. The staves and water went in all directions, and some pieces of hoop and staves landed 150 ft. away. Fortunately no one was hurt. The pump house directly at the side of the tank was completely demolished, but the machinery was only slightly damaged. In rebuilding the tank, 3 × 10 and 10 × 10-in. joists, spaced 8 ins. c. to c., were used.

Although the supporting frame did not give way, the fact that the tank itself was demolished was taken to be sufficient reason to class the accident as a total failure in the final discussion.

References.—Engineering News, Vol. XXXII., pp. 63, 114 (July 26, Aug. 9, 1894).

Pelican Sawmill, La., Sept. 20, 1894.

On Sept. 20, 1894, a timber trestle, built to support two water tanks of 50,000 gallons capacity, at the Pelican Sawmill, New Orleans, gave way, and a man engaged in painting the tanks was killed. The tower was 50 ft. high, built of timber 12 × 14 ins., and the tanks are said to have contained only 15,000 gallons of water at the time of the accident.

An attempt to secure additional information relative to the causes leading to the failure was unsuccessful.

References.—Engineering News, Vol. XXXII., p. 243 (Sept. 27, 1894).

Anthony, Kan., Jan. 20, 1895.

The 12 × 150-ft. wrought iron stand-pipe at Anthony, Kan., was wrecked by a severe windstorm during the night of Jan. 20, 1895. Pumping had ceased some six hours previous, and there was about 140 ft. of water in the stand-pipe at the time of the accident. The wind blew from the northwest, and the structure fell to the southward. The first course of plates was torn entirely loose from the bedplate, the water escaping at the base without serious damage to surrounding property. The metal shell was flattened out and was broken into three pieces by the force of the fall, as may be seen in the view of the ruins, Fig. 30.

The stand-pipe was secured by ten guys, arranged in two sets of five each in alternation, attached to collars or rims at 12 and 42 ft., respectively, from the top. The lower ends of the guys were fastened to masonry anchors. No data were secured in relation to the thicknesses of the plates nor the details of the riveting.

In seeking a cause for this accident, the evident similarity between it and the Dodge City failure in all essential features leads at once to the belief that the same explanation applies to both. The theory already assigned for the Dodge City failure assumed the rupture of the windward guy or guys, so that the remaining guys acted to augment the strain at the base on the windward side of the stand-pipe, where a flaw probably existed. While it must be granted that the increased number of guys at Anthony tends somewhat to discredit the theory as stated, it is here adopted as being the most plausible. It is very certain that the wind could not have overturned the nearly full tank weighing not far from 1,000,000 lbs. An inspection of the view, Fig. 30, indicates that the initial fracture occurred on the windward side in the line of single riveting at the edge of the bedplate.

In the absence of holding-down bolts or other anchorage at the base of the stand-pipe, it is obvious that the rivets connecting the bed-plate to the base angle would be thrown in tension on the windward side in the event of the failure of the windward guys during a severe windstorm, assuming that the combined wind and guy moment exceed the gravity moment of the tank itself. The contained water serves to hold the bed-plate tightly to the foundation, and also has the effect to steady the metal shell as a whole under the action of the gusts of the storm. It is learned that the Anthony stand-pipe had leaked about the base. It is very certain that poor workmanship would tend to increase the danger of a failure in the manner above detailed

It is stated that the upper rim or collar to which the guys were attached was first carried away by the wind, but as is often the case in a wreck, "

* A press despatch to the New Orleans "Picayune," dated April 20, states: "The tower of the water-works plant has been filled to its full capacity and now stands perfectly plumb."

it is manifestly difficult to distinguish between cause and effect, so that the ruptured collar may have been a result rather than a cause of the accident. Further consideration will be given to this and to the two related failures at Caldwell and Dodge City, Kan., in the discussion at the conclusion of this Appendix.

The following information relating to the storm which led to the Anthony failure was obtained through the courtesy of the local observers of the U. S. Weather Bureau, at the nearest stations having self-registering anemometers:

Observing station.	Distance (miles) and direction from Anthony.	Velocity (miles per hour) and direction of wind.
Wichita, Kan.	50 n.e.	41 n.w.
Dodge City, Kan.	115 w.n.w.	38 s.w.
Oklahoma, Okla.	120 s.s.e.	30 n.w.

References.—Engineering News, Vol. XXXIII., p 97 (Feb. 14, 1895). The Anthony (Kan.) "Republican," Jan 25, 1895. Correspondence with the Superintendent of the Anthony Water-Works, and with U. S. Weather Bureau Observers, as noted above (1895).

Pana, Ill., June, 1894.

The 20 × 100-ft. stand-pipe, which was completed and put into service at Pana, Ill., in June, 1894, was observed to be out of plumb shortly after it had been put into use. An examination at the time revealed no defect either in the foundation or elsewhere in the structure. The stand-pipe was found to be 5 ins. out of plumb. The above information was obtained from Vorhees & Witmer, Engineers of the Pana Water-Works, who have also given the following details of the foundation and explanation of the trouble:

> The foundation is a monolith of Portland cement concrete extending eight feet below the surface of the ground, where it rests on a compact, gravelly clay, so hard that it required picks to remove it.
>
> We cannot offer any good explanation of the trouble except that when the stand-pipe was first filled the inlet pipe broke, letting the water out. Although it drained off quite rapidly through a trench, the water may have softened the earth under that side of the foundation (which up to that time had been exceedingly dry) and rendered it more compressible. It is toward this side that the stand-pipe leans. It would require a settlement of only 1 in. on that side of the foundation, if the other side remained firm, to divert the top of the pipe 5 ins. The weight on the soil under the foundation, including water, steel and foundation, is 1.44 tons per sq. ft., which is certainly not severe for such soil as that under this foundation.

The stand-pipe has remained in uninterrupted service. It is stated that little apprehension is felt as to the safety of the structure, as it is believed that the foundation has settled intact toward the one side.

References.—Correspondence with the designing and constructing engineers, Pana Water-Works (1895).

Griswold, Ia., April 13, 1895.

On April 13, 1895, the 10 × 100-ft. stand-pipe at Griswold, Ia., when filled for the first time began to settle to one side, the top of the structure moving 2 or 3 ft. out of plumb. Owing to lack of time, further information could not be obtained before going to press.

References.—The Atlantic (Ia.) "Telegraph," April 17, 1895.

Discussion.

The number of cases included in this Appendix is hardly such as to demand a tabulated classification. The following brief summary will serve the purposes of the discussion:

(1) Chicago, Ill., 1854.
Leaning brick tower. No damage.

(2) Erie, Pa., 1872.
Buoyant action of ice cylinder. Slight damage.

(3) Wilmington, N. C., 1881.
No bedplate. No damage.

(4) Holbrook, Mass., October, 1887.
Tilted slightly by windstorm. No damage.

(5) Hampton, Ia., March 26, 1893.
Manhole connections burst out by falling ice.

(6) Dodge City, Kan., July 1, 1893.
Wrecked during severe windstorm. Total failure.

(7) East Providence, R. I., Aug. 29, 1893.
Tilted slightly by gale. No damage.

(8) Holdrege, Neb., April, 1894.
Leaked; leaned; base angle, first course plate and inlet pipe collar cracked. Slight damage.

(9) Billingsport, N. J., May 15, 1894.
Elevated wooden tanks; floor system gave way. Total failure.

(10) Bayshore, N. Y., May 20, 1894.
Shank of inlet pipe cracked during gale. Slight damage.

(11) Pana, Ill., June, 1894.
Leaned. No damage.

(12) Newport, Ark., July 9, 1894.
Elevated wooden tank; frame gave way. Total failure.

(13) Salem, S. D., July 13, 1894.
Elevated wooden tank; floor system gave way. Total failure.

(14) Pelican Sawmill, La., Sept. 20, 1894.
Elevated wooden tank; frame gave way. Total failure.

(15) Anthony, Kan., Jan. 21, 1895.
Wrecked by wind. Total failure.

(16) Thibodaux, La., March 29, 1895.
Leaned. No damage.

(17) Griswold, Ia., April 13, 1895.
Leaned. No damage reported.

A review of the foregoing matter suggests several noteworthy observations, some of which were brought out in the original record. Of the new points here developed, reference may be made to the possibility of damage to the base angle by the deterioration of the mortar bed beneath the bedplate about the edges. Another matter not encountered in the original record is the need of providing against strains in the inlet pipe at the point where it is connected with the tank or its foundation. This matter involves consideration of the settlement of the foundation itself, and the two are closely concerned in the importance of providing efficient drainage for the stand-pipe site. Still another related matter is the proper construction and maintenance of the seams, and this again bears upon the necessity of frequent attention to the preservation of the exposed metal surfaces from corrosive influences.

In connection with the description of the accident to the Stevens Point, Wis., stand-pipe in the original record, an account was given of experience with ice at that place along several lines, among which reference was made to the protrusion of the great tube of ice above the top of the stand-pipe. It is seen that the incident at Erie, Pa., described in this Appendix, is a similar illustration of the possible buoyant action of ice in stand-pipes, and it is very evident that the danger to be feared from such an occurrence is by no means limited to the upward force. That force should have critical consideration when the use of a roof is contemplated, but it is important in all cases to recognize the imminent danger that may result from so enormous a weight becoming fastened in its elevated position, and subsequently falling when the stage of the water is low. Valuable corroborative proof that extreme caution is demanded during periods of alternating thaw and freeze is found in the accident at Hampton, Ia. This danger seems to be greatest during the month of March. In this connection it seems timely to refer to the fact that the danger from such accidents may be even greater in a locality where icy winters are the exception rather than the rule, for the reason that those responsible for the safety of the stand-pipe are less apt to be on the alert than where ice usually forms in excessive quantities. The subject of ice action in stand-pipes was quite fully considered at the conclusion of the original record, but the importance of the subject warrants further reference to it.

FIG. 30. VIEW OF STAND-PIPE RUINS AT ANTHONY, KAN.; LOOKING SOUTHEAST.

Referring to the omission of a metal bottom in the construction of a stand-pipe, it should be stated that such omission is not of itself alone to be condemned, as is conclusively proven by several stand-pipes which have been so built with entirely satisfactory results. However, where such a plan is adopted, it is clearly incumbent upon the designer and builder to provide the equivalent of the bedplate in tightness and safety by the use of correctly designed and executed calking grooves and shoes.

The alarming frequency with which failures of elevated wooden tanks have taken place recently possibly warrants the inference that a financial

TABLE XI.—Data Relative to Stand-Pipes Which Have Been Lifted More or Less On the Windward Side During Violent Windstorms.

Item.	Holbrook, Mass., Oct., '87.	E. Providence, R.I., Aug. 29, '93.	Kankakee, Ill., Oct. 14, '86.	Plattsmouth, Neb., Apr. 9, '87.
(a) Diameter of stand-pipe, ft.	30	40	20	25
(b) Height " " "	112	120	124	80
(c) Projected area of cylinder, sq. ft.	3,360	4,800	2,480	2,000
(d) Approximate weight of tank, lbs., total	300,000	500,000	140,000	100,000
(e) Approximate horizontal force, acting midway of height, required just to balance the force of gravity, lbs., total	80,360	166,670	22,580	31,250
(f) Average unit pressure per projected sq. ft. of the cylindrical surface, corresponding to (e), lbs.	23.9	34.7	9.1	15.6
(g) Maximum velocity of the wind (as it would probably have been indicated by an anemom. located at stand-pipe), miles per hour	50	60	40	40
(h) Corrected velocity corresponding to (g), miles per hour	(41)	(48)	(33)	(33)
(i) Static pressure, per sq. ft. of flat surface, corresponding to the velocities in (h), as computed by formula (l), lbs.	6.7	9.2	4.4	4.4
(j) Resulting total static pressure on stand-pipe in the direction of the wind, the resistance of the cylindrical surface being assumed at one-half that of a normal flat surface having an area equal to the projection of the cylinder, lbs., total	11,250	22,080	5,460	4,400
(k) Average unit pressure per projected sq. ft. of the cylindrical surface, corresponding to (j) (equal to one-half of (i)), lbs.	3.4	4.6	2.2	2.2
(l) Ratio of (e) to (j), or of (f) to (k)	7.1	7.5	4.1	7.1
(m) Effect produced by windstorm on the stand-pipe	Slightly lifted.	Slightly lifted.	Rocked, collapsed, overturned. —Anchorage failed.—	Rocked, collapsed.

policy, which has prompted the selection of a supposedly cheap structure, has been allowed to obscure the principles of genuine economy so far as to violate the essentials of safe construction. The recognition of the legitimate field of the temporary structure, and its unquestioned merits under certain conditions, does not, under any circumstances whatever, warrant a sacrifice of the element of safety.

Of the three agencies—water, ice and wind—which, it has been seen, may endanger the stand-pipe, less seems to be known of the action of the last named than of the other two. This fact warrants the introduction of any data which may serve to throw light upon this complex question, particularly since there seems to be a division of opinion among engineers as to the necessity of providing special anchorage for stand-pipes.

In discussing Table V., of the original record, in which were grouped the "wind" accidents, the assertion was made that little reliance can be placed on gaged wind velocities. That conclusion was reached only after repeated and unsuccessful attempts to reconcile computed pressures and observed phenomena in the cases investigated. The collection and consideration of other data of an exceptionally complete and reliable character throw new light upon the subject and prompt a a qualification of the assertion above referred to.

It is the purpose of Table XI. to determine the possible influence of concurrent vibration and impact of the wind upon stand-pipes. In this table are grouped "data relative to stand-pipes which have been lifted more or less on the windward side during violent windstorms." In addition to the two cases, Holbrook and East Providence, given in this Appendix, the table embodies data relating to the Kankakee and Plattsmouth accidents from the original record. In each of the four cases the tank was entirely empty at the time of the accident or incident. In the first two cases no anchorage had been provided, because of the belief that none was needed. Holding-down bolts were provided in the other two, but owing to the deficient connection with the foundation in the case of Kankakee, and a defective bolt at Plattsmouth, the anchorage failed in both cases.

Except in the matter of diameter and heights, no attempt at exactness has been made in the figures contained in Table XI. Thus, in fixing the weights, that of the Holbrook stand-pipe is taken at 300,000 lbs., although its actual weight, as stated in the description of that incident, is somewhat less than this amount. The weights of the other three are also approximate, having been computed. Item (e) gives the horizontal static force, which, acting midway of the height, would be required just to balance the weight of the empty tank, neglecting consideration of anchorage at the base, or adhesion of the bedplate to the foundation. The next item, (f), presents the mean pressure per projected square foot, found by the division of (e) by (c), the purpose of which will directly appear.

In estimating the velocities of the wind, the nearest anemometric records during the same storm have been utilized. These assumed velocities are, of course, subject to such errors as may result from local variations of intensity in the storm, but they are as nearly correct as it may ordinarily be possible to secure, and, besides, it will be seen that they may be materially in error without nullifying the results and conclusions reached in the inquiry. The velocities assumed for Holbrook and East Providence are, it is believed, justified in the descriptions of those cases. In the case of Kankakee the assumed velocity is based upon observed velocities of 34 and 36 miles per hour at Springfield and Chicago, Ill., respectively. The velocity taken for Plattsmouth was fixed with respect to an observed velocity of 36 miles per hour at Omaha, 20 miles distant. It should be stated that much higher values were assigned for these two cases in Table V., in an attempt to make the velocities more nearly consistent with the observed effect of the storm. The selection of even ten-mile values is in keeping with the approximate character of the table.

The "corrected velocities" given under item (h) were obtained from the reduction table used by the U. S. Weather Bureau in connection with the records obtained from the standard government anemometer.*

In item (j) the pressure of the wind on the cylindrical surface is taken at one-half that on a normal flat surface, having an area equal to that of the diametral plane of the cylinder. This assumption accords with the recommendations of Rankine (Applied Mechanics, p. 240), and is supported by the results of recent experiments by Professor Kernot, of the University of Melbourne.** It should be stated, also, that this is the usual assumption made in practice, although some use a value as high as two-thirds. Item (k), corresponding to (f), is obtained in an obvious manner.

The real purpose of Table XI. is fulfilled in item (l), in which are expressed what may be termed the ratios of "force exerted" to "force apparently available." That this ratio should exceed four in one case and seven in the other three is without question a startling fact. The close agreement in the ratios determined in three of the cases is not an essential feature of the investigation, inasmuch as precision was not attempted in fixing the velocities. However, this agreement of results may be justly taken as a proof of the general correctness of the basis of the assumed data. It is of interest to observe that overturning took place only in the case having a low ratio, and it is seen that this structure also had the lowest factor of stability. Careful consideration of the methods by which these ratios were obtained in connection with the information contained in the last item, (m) of the table, leads to the belief that the ratio in the case of Kankakee was probably considerably greater just previous to the failure of the anchorage. Since collapse took place after the failure of the anchorage in the last two cases, the increased pressure of the wind, due to the formation of the flattened top, has not been considered in the above investigation.

The explanation of the paradox indicated by the results in Table XI. are of a twofold character. First, and probably most important, is the element of coincident vibrations of the structure and gusts of the wind, to which reference has been made in various connections in both the original and supplementary records. The other agency to which reference is above made is the prevalence in the storm of bursts of velocity, which were so momentary in their action as to find no recognition by the comparatively sluggish anemometer.

That such is true even of winds of low velocity has been shown by recent experiments, in which auxiliary anemometers of an exceedingly delicate character were used. Thus, for example, it was found that with a wind indicating a velocity of but 20 miles per hour by the standard anemometer, registering only every mile of travel, the more sensitive instrument showed momentary spurts as high as 60 miles per hour. Simultaneous observations of velocities and pressures made on the summit of Mt. Washington in 1890 developed a similar fact, as indicated by fluctuations in the pressure diagram. These experiments and the deduction of the coefficient of formula (1) were described in the valuable contribution on "Wind Pressures and the Measurement of Wind Velocities," by Prof. C. F. Marvin, which appeared in Engineering News of Dec. 13, 1890.* The concluding paragraph of the paper has a direct bearing upon the subject of impact of wind, and is as follows:

> In estimating the strains to which engineering structures may be subjected by winds, the maximum pressures are, of course, the most important. The above formula gives a mean pressure corresponding to a mean wind velocity. It is important to note that momentary pressures as much as 35% in excess of the above mean pressure may continually occur and recur. If their rate of occurrence be at all synchronous with the natural time of vibration of the structure or any part thereof, remarkable results may follow.

The facts and statement above quoted, undeniably find strong confirmation in item (l) of Table XI. In concluding this discussion of the action of wind upon stand-pipes, it seems proper again to comment upon the belief which seems to prevail in some localities, that stand-pipes do not ordinarily require other anchorage than is afforded by the dead weight of the empty tank. Even admitting that the probability of entire destruction of the stand-pipe by the action of wind may be exceedingly remote, the relatively small cost of providing against an emergency, which may occur in the life of almost every stand-pipe, seems to remove all defense of the omission of such provision.

An effort was made to include in the above inquiry the case of the Dodge City stand-pipe, but it was found impracticable to fix a definite basis for the effect of the guys. In fact, as already stated in the description of that accident, and the precisely similar one at Anthony, Kan., it seems very certain that the stand-pipes referred to would not have failed at all had not the guy action become unsymmetrical by the failure of the windward guys. Furthermore, it seems altogether plausible that the overturning of the guyed stand-pipe at Caldwell, Kan., in 1886, while empty during construction, described in the original record, was due to the same cause. The dimensions of these three guyed structures were quite similar, being 12 × 150, 12 × 100 and 12½ × 150 ft., respectively. Perhaps the most interesting and also significant relation between them, however, is found in their geographical position, the three being on an almost exact west-northwest line, the distance from Dodge City to Anthony being about 115 miles, and from Anthony to Caldwell about 25 miles. These accidents raise the question of the propriety of depending upon guy anchorage alone, particularly in the case of the type of tall and slender stand-pipes that prevails in many towns of small size in the Western prairie states. It is believed to be a wiser plan, and the one toward which a number of careful designers seem to be tending, to secure a widened base by means of properly designed brackets, and to stiffen the upper portions of the structure so that guys are unnecessary.

In conclusion, it seems desirable to summarize briefly the foregoing records. A total of 45 cases have been described, 28 of which were in the original record,and the remaining 17 in this Appendix. Of these, 23 were total failures, the others ranging

(Concluded on p. 294.)

* Following is an extract from the reduction table for even ten-mile velocities, taken from a circular issued by the U. S. Weather Bureau:

Velocity indicated by standard U. S. Weather Bureau anemometer (velocity in miles per hour):									
0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0
Corresponding corrected velocity:									
0.0	9.6	17.8	25.7	33.3	40.8	48.0	55.2	62.2	69.2

The pressures stated in item (l) were determined by the substitution of the "corrected velocities" in the following formula:

$$P = 0.0040\ V^2. \qquad (1)$$

in which P = pressure of wind in lbs. per sq. ft. and V = velocity of wind in miles per hour.

In computing velocities corresponding to given pressures, the following expression derived from (1) has been found convenient:

$$V = 1/2\ (1{,}000\ P)^{1/2} \qquad (2)$$

Equation (1) differs from the old Smeaton rule for wind pressures only in the coefficient, the earlier value being 0.005. The form of this expression has been criticised by some authorities, but its proper use seems to be entirely consistent, at least until it is replaced by a more trustworthy expression. The value of the coefficient was determined experimentally, but there is much need of more extended experiments which will include larger surfaces and higher velocities. In presenting this formula, the circular above referred to states that the "corrected velocities" are to be used, and in commenting upon both the reduction and pressure formulas, it is explained that while they "give results more nearly correct than before obtained, yet, owing to the great difficulty of making accurate experiments at high velocities, these adopted values may ultimately need comparatively small corrections."

The formula deduced by Prof. Langley, of the Smithsonian Institution ("Experiments in Aerodynamics," 1891), has the same form as (1), and is probably the most trustworthy in use. The value of the coefficient is 0.0036 for a barometric pressure of about 29 ins. and temperature of 50° F. At a freezing temperature and with a normal barometer the Langley coefficient is slightly less than that used in equation (1).

** Recent experiments by Irminger, a Danish engineer (Engineering News, Vol. XXXIII., p. 110, Feb. 14, 1895), fix this ratio at 0.57. Bixby, an American authority (Engineering News, Vol. XXXIII., p. 183, March 14, 1895), adopts a value of 0.60 for use in bridge design. The use here of the somewhat smaller ratio of 0.50 does not affect the character of the conclusions reached by means of Table XI.

* Since this reference to the Marvin experiments was put in type, a very elaborate and valuable monograph on "Wind Pressures in Engineering Construction," by Capt. W. H. Bixby, M. Am. Soc. C. E., has appeared (Engineering News, Vol. XXXIII., pp. 175-184, March 14, 1895). Careful study of the work referred to confirms the belief that the premises upon which Table XI. and the accompanying discussion and conclusions are based are entirely sound, and that the methods adopted in the investigation accord with good current practice. The following quotation from the Bixby monograph (paragraph 126) is of interest in connection with the statement above from the Marvin article:

> "All high-wind velocities . . . may be subject to repeated oscillations of from 30 to 40% each way from the average at half-minute intervals for several minutes, and sometimes even to an increase of 60% for nearly a whole minute."

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.
Entered at the Post Office, New York, as Second Class Matter.

VOL. XXXIII. THURSDAY, MAY 2, 1895.

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The French government has been prompt to recognize the responsibility of the Chief Engineer of the passenger steamer "La Gascogne" for bringing that vessel safely into port under its own steam with a disabled engine, and has awarded him the cross of the Legion of Honor. Our readers will remember the anxiety which was caused about three months ago by the long-delayed arrival of this crowded passenger steamer, which eventually came into port under its own steam, the engineers having cut out the high and low pressure cylinders on account of a fracture which could not be repaired, and thus working the engine with the four intermediate cylinders. In our issue of Feb. 14 we commented upon the successful and important work accomplished by the engineering staff, and it is with pleasure that we now record the official appreciation of this work.

The article on the Muscle Shoals canal on the Tennessee River, elsewhere given in this issue, is a somewhat telling example of the results often following our present system of distributing government funds in the improvement of rivers and harbors. As there shown, the annual cost to the national government for each ton of freight carried through this canal is $17.81; or $25 per ton if the interest on the cost of improvements in the river above the canal is added. The Congressmen advocating this expenditure doubtless dreamed of a vast future development of traffic in this region, which would justify their demands for money; but before this development can even have a beginning, untold millions more must be expended in rendering navigable nearly 600 miles of a river which is now almost dry at certain seasons of the year.

The true reason for this and similar extravagant and practically useless expenditures of public funds doubtless lies in what the writer of the article terms a system of "geographical distribution" of these funds among Congressmen clamoring for a recognition of local demands for a due share in the public plunder, regardless of economic considerations. It is a wasteful system, and will probably prevail as long as the average Congressman continues to decide where and how the money appropriated for this purpose should be expended. It is human nature to grab all he can for his constituency, feeling that the actual expenditure of the money necessary for construction will benefit his section, whatever the completed improvement may do. Some time—no one yet knows when—it may be deemed wise to have all such proposed improvements first passed upon by an impartial and intelligent board or bureau, possessing the power to permanently reject all those which cannot show good, business-like reasons for their execution at the expense of the general government. There is abundant room for a vast annual expenditure upon projects that will actually and quickly benefit the people of large sections of the country; and all money diverted into wasteful and useless channels simply delays indefinitely the greater legitimate enterprises.

The city of Philadelphia is seeking for a new Chief of the Bureau of Water to replace the late incumbent, who recently resigned. The position is worth $6,000 per annum, and, under the civil service rules of the City Charter, a board of examiners will investigate the qualifications of all applicants. The interesting question arises whether this is the best method of obtaining the man qualified to act as the head of so important a bureau in a city of over one million inhabitants. As compared with the former method of leaving this selection in the hands of the average City Councilman, we think it is. But much will depend upon the spirit in which the board of examiners goes about its work, and to what degree it appreciates the responsibility placed upon it and the true requirements of the office. It is well to have some independent and thoroughly capable board, outside of the municipal authorities, officially responsible for the selection, and to that degree the new departure is to be commended. But such a board will have to depart widely from the methods of examination ordinarily applied when it is a mere question of culling from a mass of applicants for minor positions those best fitted by previous training and experience. If fitness for a bureau chief is to be determined by a similar series of questions and answers upon technical subjects, we will venture to say that some of the really best fitted men will make low averages and fail to pass their examination. To fill such a position properly, much more is required than due familiarity with formulas and rudimentary engineering problems. Broad, general experience in the actual design and construction of work, business qualifications or worldly wisdom, only attained by years of hard work, unimpeached personal character and executive ability of a high degree are the qualifications actually needed; and the man possessing these, even though he has forgotten some of the rules of minor practice, is the man who will best perform the public service required of him. A well-earned professional reputation and an unassailed personal character fill all the true conditions of the case, and an honest and careful investigation into these two points should practically close the civil service examination in such cases. All else is simply minor and useless detail, and may result in defeating the real end in view. It is evident that the true interests of the citizens of Philadelphia in this case will depend quite as much upon the character and breadth of the board of examiners appointed as upon the general experience and attainments of the applicants for the office; and it is especially important that in this and in all similar cases, very careful consideration should be given to the selection of the board.

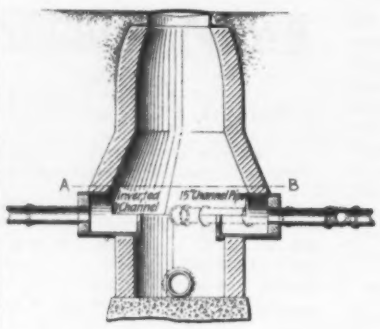
Very few comprehensive tests have been made in England or America to determine the effect of freezing upon the strength of cement mortar. German and French engineers have done somewhat more in this direction, but even with them such tests have been comparatively few in number, and, besides, are hid from the great majority of American engineers by the language in which they are published. On this account the elaborate series of tests described elsewhere in this issue are of no small interest, if for no other reason. We think, however, that a careful study of the figures will develop many ideas and suggestions of value to cement users. In a general way it has been considered that freezing does comparatively little injury to Portland cement mortar, but that natural cement mortars are almost certain to disintegrate partly or wholly if frozen. In the same general way it has been considered that the admixture of salt to the gaging water does much to prevent the injury of cement mortar from freezing. Both of these general assumptions are pretty thoroughly corroborated by the tests just mentioned; but just how much farther we are justified in accepting for general application the other conclusions reached by the paper, is a question.

Probably the most anomalous conclusion reached by the authors in conducting their tests is that with "natural cement mortar an increase of strength appears to be acquired under the conditions which it passes through while frozen." There seems to be no inherent reason why such a result should be found with natural cements and not found with Portland cements, and the evidence furnished by the small number of tests is hardly weighty enough to overbalance the probabilities that two classes of the same material so nearly alike in composition would develop similar characteristics under similar conditions.

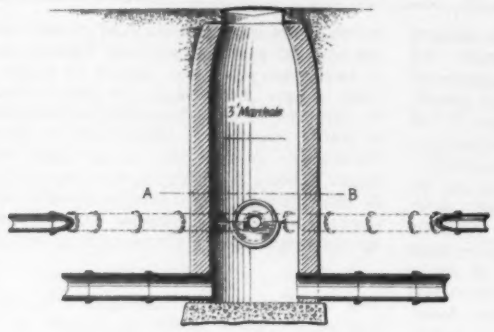
The action of the water in freezing cement mortar is to retard partly or wholly the setting, and to force apart the particles by its expansion, and the result of this action is to partly or wholly disintegrate the natural cement and to weaken considerably the Portland cement. Thus far the action of frost seems to be analogous with both classes of cement; but a little farther on we find according to the tests that the sound portion of the cement that is partly blown to pieces by the frost is stronger than the same cement unfrozen, while the cement that has resisted the disruptive action of the frost is very much weaker than the same cement unfrozen. This is paradoxical, to say the least; but even if it be true that freezing increases the strength of the undisintegrated core of natural cement, it is noteworthy as a curious phenomenon rather than as being of any great practical value to engineers, since the very fact that a partial disintegration takes place, puts natural cement out of consideration when important work has to be done in freezing weather.

The next conclusion worthy of note which is reached by the authors is that regarding the action of freezing upon a mixture of natural cement and Portland cement. This conclusion, it may be noted in passing, seems to argue the truth of the phenomenon noted above. It is in brief that a mixed cement seems to combine the quality peculiar to Portland cement of not disintegrating when frozen with the quality indicated above for natural cement of attaining an excess of strength by being frozen. These tests seem to be pretty conclusive as far as they go, but they cover only one brand of mixed cement, and should be accepted with a reservation as to the general applicability of the results. The other conclusions reached by the tests call for no special mention beyond that made in the paper.

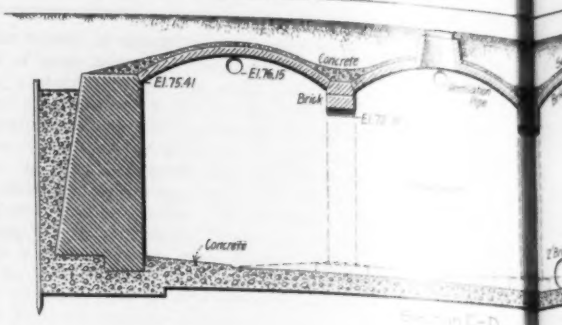
As to the suggestions which these tests offer for future investigation, a few words should be said. It seems prettly well settled that the injurious effect of freezing upon cement mortars is largely a mechanical effect; the disruptive effect due to the expansion of the water in assuming a crystalline state. The same effect exists when brick or stone hold water in absorption, and with mortar, as with brick and stone, it would seem natural that the injury should be greater when the masonry is subjected to alternate freezing and thawing. Comparative tests, then, need to be made to determine the effect of alternate freezing and thawing upon cement mortars. It is known that an over-clayed cement absorbs more water than one containing less clay, and it needs to be determined just how far this increased amount of water gives an increased effect to the action of the frost. The paper indicates that a mixed Portland and natural cement acts peculiarly well under frost. This needs to be confirmed by testing different mixtures and brands of these popular cements. Tests to corroborate the conclusion reached by the authors regarding the peculiar increase in the strength of natural cement mortar during freezing are also needed before much importance can be attached to the results already given. This last is, however, of less importance than either of the three tests preceding it. The determination within fairly close limits of any of the points mentioned will establish a valuable basis for determining good practice in the conduct of masonry work in cold weather.

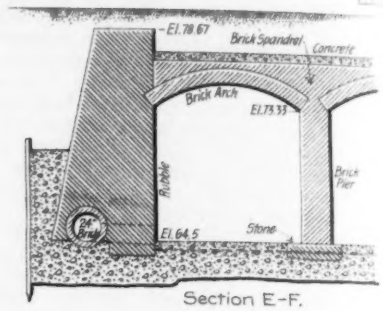


Section C-D.



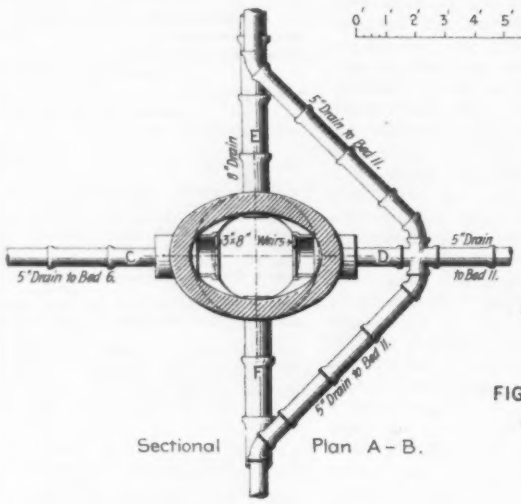
Section E-F.



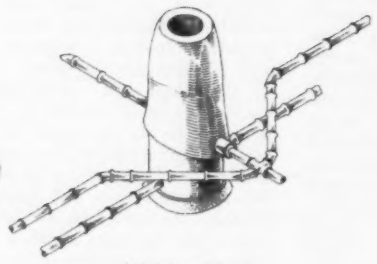


Section E-F.

FIG. 2. SECTIONS OF RESER

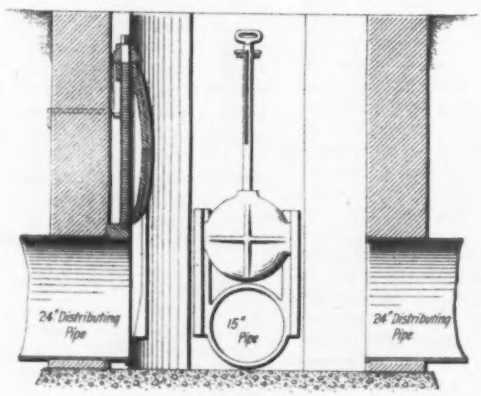


Sectional Plan A-B.

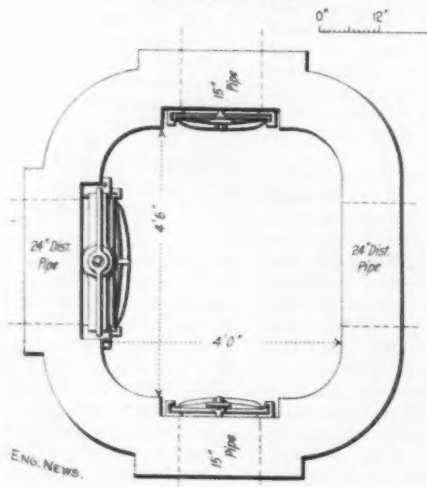


Isometric View.

FIG. 9. MANHOLE AND UNDERDRAIN CONNECTIONS IN FILTER BEDS.



Vertical Section.



Plan.

FIG. 8. DISTRIBUTING CHAMBER.

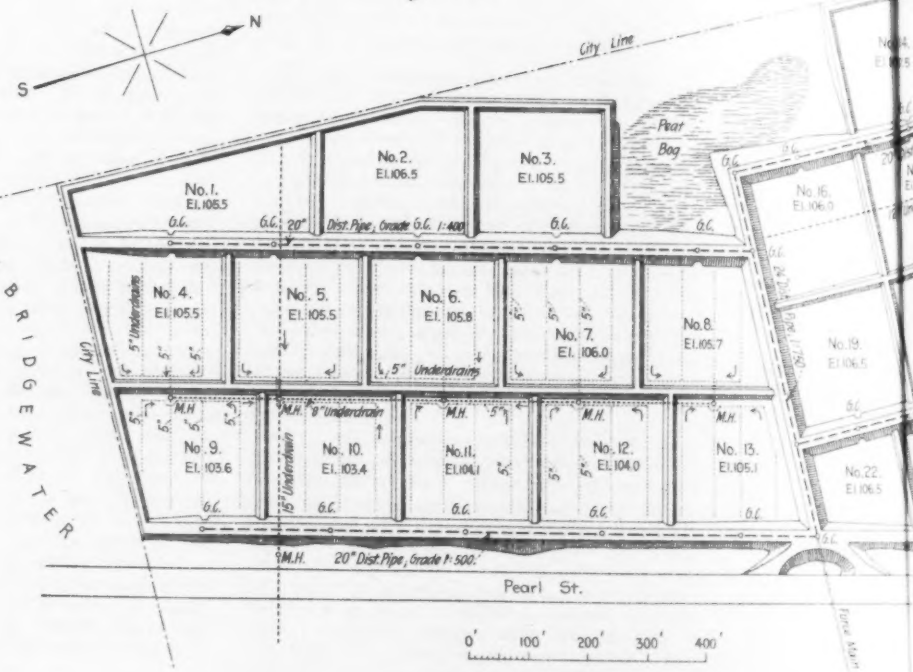


FIG. 4. PLAN OF FILTER BEDS.

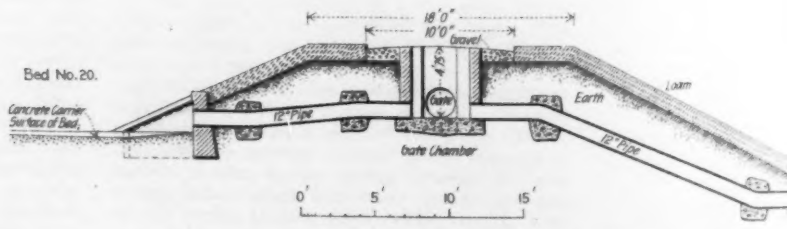
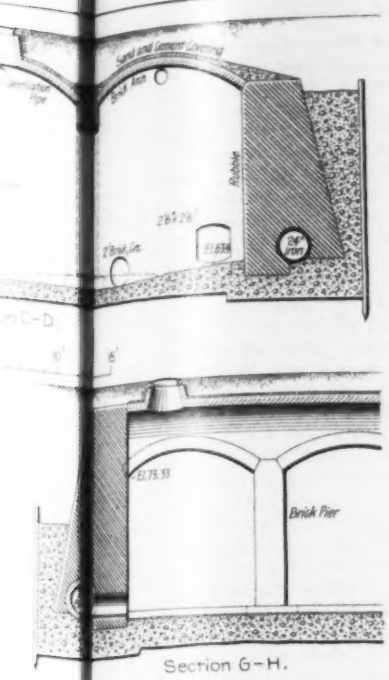


FIG. 7. SECTION THROUGH EMBANKMENT BETWEEN BEDS 20 AND 2

SEWAGE RECEIVING RESERVOIR AND

F. Herbert Snow



ONS OF RESERVOIR.

20 AND 23.

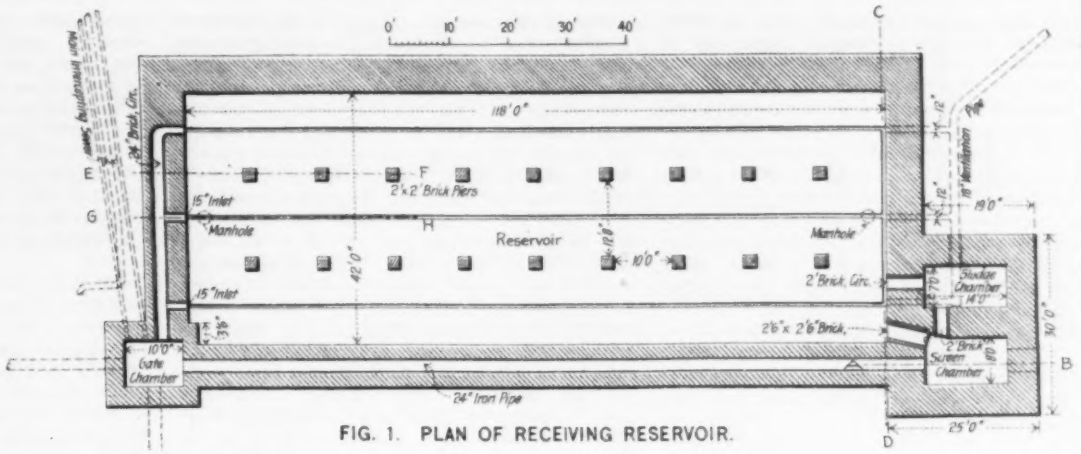
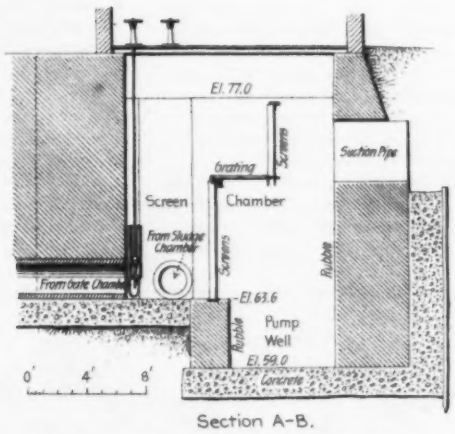


FIG. 1. PLAN OF RECEIVING RESERVOIR.



Section A-B.

FIG. 3. SECTION THROUGH SCREEN CHAMBER.

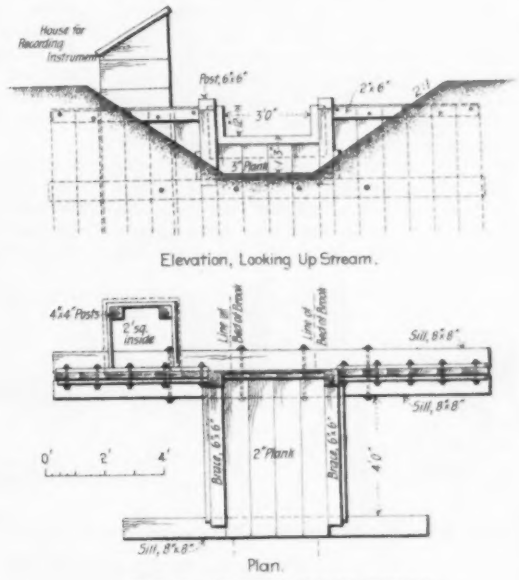


FIG. 5. WEIR IN DALEY BROOK.

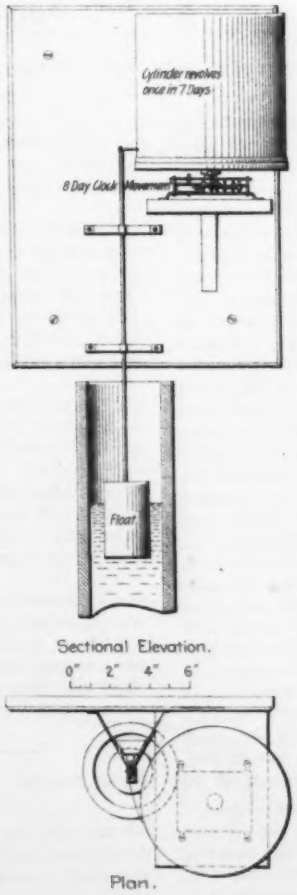


FIG. 6.
AUTOMATIC RECORDING INSTRUMENT AT WEIR.

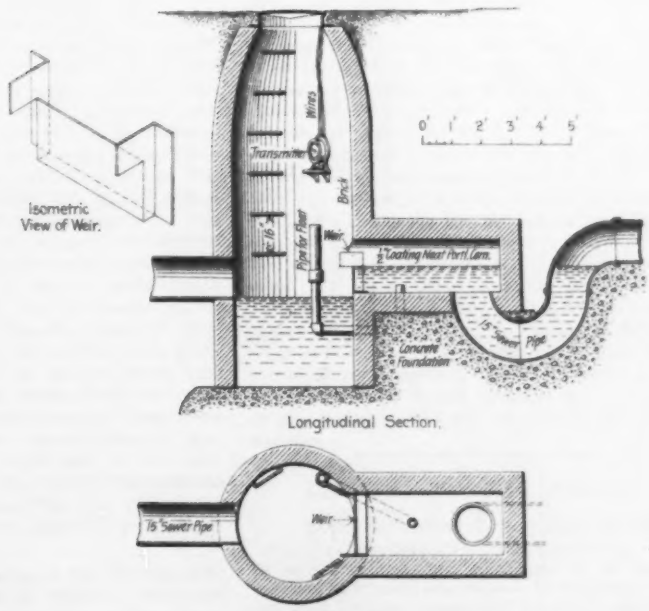


FIG. 10. MANHOLE AND WEIR
ON 15-IN. MAIN UNDERDRAIN FROM FILTER BEDS.

R AND FILTER BEDS AT BROCKTON, MASS.

rt Snow, City Engineer.

CHAS. HART & SONS, LITH., 99 VESEY ST., N. Y.

A slight change in the Jersey City water situation has taken place since our last issue. Corporation Counsel Blair has advised the Street and Water Board that it could permit no changes in the formal bids before it, which shuts out the plan of calling for new propositions from formal and informal bidders. He stated two alternatives in case the Board decided to reject the present bid: (1) A contract for a new supply could be made with any party without advertising; (2) if new propositions are asked it must be by formal advertisement.

The present Board goes out of office on or about May 7. It had had the two bids under consideration since March 25, and on April 29 it awarded the contract, so far as it was concerned, to the Jersey City Water Co. The Board of Finance must concur in, and the Mayor, we are informed, must approve this action before the award is completed. The Finance Board met on April 30 and postponed final action on the award for one week. Meanwhile, if it acts in accordance with the wishes of the Street and Water Board, it will consider the two formal and the four informal bids; in fact, review the whole situation, instead of merely weighing the merits of the bid of the Jersey City Water Co.

If the Finance Board concurs in the award to the Jersey City Water Co., the new supply will be by gravity from the Rockaway watershed through some 29 miles of conduit, and a storage capacity of about 11,000,000,000 gallons will be provided, or 234 days' supply at 50,000,000 gallons per day. The price for the works, with one conduit, will be $7,000,000, and the price for water until the city buys, $39.75 per 1,000,000 gallons for 20,000,000 gallons a day, $34.40 for 50,000,000 gallons and intermediate prices between these amounts.

In making the above award the Street and Water Board acknowledges that the proposed watershed of the Jersey City Water Co. is inadequate (see also correspondence in Eng. News for April 18), and indicates how the supply could be supplemented from the Rockaway River direct, at the point where the conduit would cross the stream, or by adding to the drainage area.

It is not too late for the city to make an entirely new start along the lines already suggested in these columns. Condemn necessary sources of supply, after deciding which ones are the best; then ask bids and let contracts for construction alone, thus securing real competition from the hosts of able men who would be glad to bid on this work, but have been excluded from doing so under past plans.

The award of the contract as now proposed might be at least the second-best thing for the water syndicate whose growth we traced last week, for while this would deprive it of the contract, the successful bidder would have to satisfy the syndicate's claims in the Rockaway watershed, or engage in a hard legal conflict.

THE LOCATION OF THE NICARAGUA CANAL.

In commenting in our issue of April 4 upon the recent appointment of an engineering commission to examine and report upon the present plans and estimates of the Nicaragua ship canal, mention was made of the advisability of further investigating the location of the eastern end of the route. These comments have brought out considerable correspondence from engineers, some of them formerly engaged upon the canal surveys, and these have led to our investigating somewhat more closely the existing conditions and the physical reasons controlling the present location. In this investigation we are indebted to the courtesy of Mr. A. G. Menocal, Chief Engineer of the Nicaragua Canal Construction Company, for notes and maps of actual survey and other information here used.

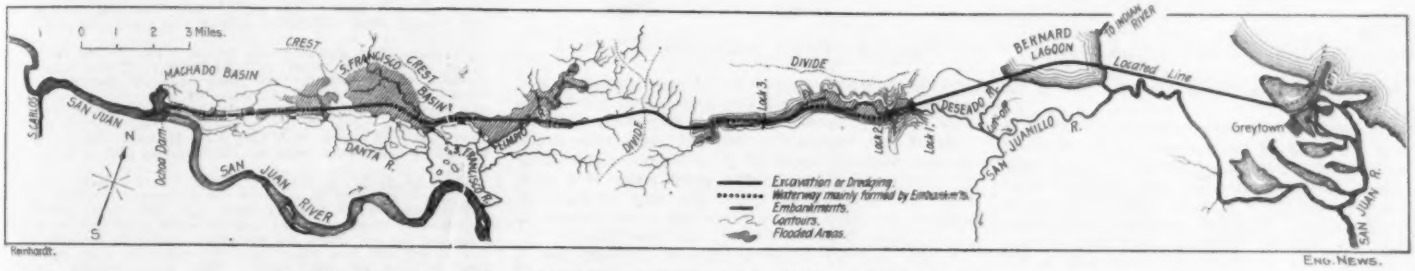
As shown by the accompanying map of the eastern section of the present location of the Nicaragua Canal, the crest-line dividing the drainage basins of the San Juan and Indu rivers, lying to the north and practically parallel with the San Juan, approaches very close to the latter river. The comparatively small size of the rivers San Francisco, Limpio and Deseado, flowing from the north into the San Juan, has been commented upon by some correspondents, when taken in connection with the enormous rainfall of the region and the volume of the San Carlos and Serapiqui, emptying into the San Juan from the south. Streams have been found immediately beyond the crest-line, indicated on the map, flowing to the north, and apparently emptying into the Indu River, and it has been suggested that further surveys might possibly find a lower pass through the divide than the present located cut.

In this connection we find that the country in question has been explored, with this end in view, by Messrs. Menocal, Peary and other engineers connected with the government and canal company's surveys. The peculiarity of limited northern watershed to the San Juan, east of Ochoa, has been carefully utilized in the present location of the canal line parallel to the crest-line and as close to it as the topography will permit. The important purpose of this location is to eliminate, as much as possible, the danger to the canal from floods in the streams to be crossed—a danger always imminent with a tropical rainfall. By crossing these streams as near as possible to their sources, the volume of water to be dealt with is comparatively inconsiderable, and its disposal easy. This crest-line practically controlled Mr. Menocal in his location and in his advocacy of the advantages of the high-level line, as it was called; and it influenced the former advocates of the lower San Juan location to finally decide in favor of the present route. The yet unsolved problem of the disposal of Chagres floods on the line of the Panama Canal has made, and always will make, that location unfavorable for a ship canal. The fact that the headwaters of the Deseado and the San Francisco approach very close to each other, on the line of the canal, practically fix the location of the present divide cut. The further fact that the main divide branches just above the existing canal line is not suggestive of a shorter divide cut or a more favorable location immediately to the north; and in any such disposal of the canal line the crest of the northern San Juan watershed would have to be crossed, as well as the north and south crest-line represented by the present divide cut.

As to other proposed routes for the Eastern division of the canal, we find as follows: That the tortuous course of the River San Juan, from Ochoa to a point below the River Serapiqui and thence to Greytown, was originally surveyed by the U. S. Surveying Expedition of 1872-73. It was again carefully resurveyed, the location changed and improved in many places and borings made upon it by the canal company's engineers in 1887-88. The results of these surveys were then compared with what is now called the high-level line, the present route, and passed upon by a commission of the ranking engineers engaged in the two surveys. And as a result of their investigations the high-level route was adopted. The route along the river would have been not only longer, but several cuts would have had to be made, shorter but deeper than the Divide cut on the present line; and between these cuts were swamps entailing much costly work. The 12 or 15 miles lying between the River San Juan and the present line has been very carefully surveyed and studied wherever a canal location seemed possible.

As to possible routes north of the present location, the canal company's explorations extend to and beyond the crest-line dividing the watershed of the San Juan and the Rio Indu, with the result of finding higher summits and heavier work to the north of the adopted location. A study of the latest map of this section of Nicaragua shows a system of drainage basins unfavorable to canal location north of the San Juan. This latter river is the only one connecting Lake Nicaragua with the Carribean Sea. North of it there is a high divide separating the rivers, which generally flow at right angles to the lake and the sea, and empty into these two bodies of water. Between these rivers, all practically parallel to the San Juan, are other high divides, or crests, joining with the central north and south divide. It is evident from this topographical configuration that to follow any of these other rivers across the country lying between the lake and the sea would involve a very tortuous and longer route, many locks, or exceedingly deep and costly cuttings.

We have again taken up the discussion of existing and possible routes, because later investigation, with more complete data available, leads us to frankly state our belief that it is directly along the present location that any improvement on the present line must be sought for, if any improvement is to be made. The general configuration of the country to the north, taken in connection with actual explorations by those vitally interested in the best results, seems to be convincing that nothing better need be looked for there; the southern route along the San Juan has increased cost and length of route against it, and the utilization of the existing crest-line for the location of a canal has many advantages in its favor. The chief objectionable feature is that of the embankments across the Danta, or Florida Lagoon, but with existing facilities for the excavation and removal of rock, much of this work could possibly be eliminated by deeper cuttings; and this change is now being studied by the canal engineers, we understand.



LOCATION OF THE EASTERN SECTION OF THE NICARAGUA SHIP CANAL.

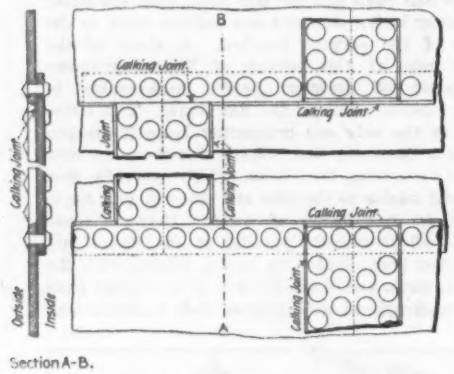
LETTERS TO THE EDITOR.

SPECIFICATIONS FOR STAND-PIPES.

Sir: Professor Pence's article in your issue of Feb. 28 on Specifications for Stand-pipes is an extremely valuable and timely contribution to the subject. There has been, no doubt, much poor practice in this branch of engineering. The custom has been, to a greater extent than in any other engineering work of like importance, to buy a stand-pipe much as a barrel of flour would be bought; the contract or agreement would be for a stand-pipe so high and so wide, the

material and workmanship to be first-class in every respect. It seemed to be thought that for so simple a thing as a stand-pipe it was not necessary to employ an engineer, and perhaps engineers were, to a certain extent, responsible for this idea, as many built stand-pipes with specifications nearly as frail as the above, and there seemed to be no effort to put the subject on a scientific basis. I presume there are many stand-pipes in existence which are supposed to have, judging from the thickness of the plates and nominal tensile strength called for, a factor of safety of from 4 to 6, which, on account of a lack of uniformity in the plates, poor design in the riveting or poor work throughout the whole structure or in certain parts of it, are strained to very nearly their real ultimate strength.

It is rather unfortunate that in a structure which is such an important part of a water-works system, the cost should be so small that it is not considered necessary to have such thorough inspection as would be required in a bridge, for instance, because the cost



Section A-B.

Method of Joining Plates in Stand-Pipes.

of such inspection is so large a percentage of the whole.

I believe the best and most satisfactory way is to place the inspection of the material at the mill and shop in the hands of an inspecting firm of good reputation, with the agreement that they shall put their private stamp upon every piece as a guarantee that it has been inspected. When the material comes upon the work, the engineer in charge can look for the stamp, and if it is not there the piece can be rejected.

It would probably not be feasible to employ a special inspector during erection on account of expense, but if the above were done, the engineer could be reasonably sure of a good job, as he should be able to pass upon the mechanical work of construction.

There are some methods of construction which it is desirable to change, but it is very difficult for a single engineer to make radical changes in his specifications, as they are usually antagonized by the makers, and result in bids in which the cost is too great, even if the actual cost is not much in excess of old methods. The design and construction of stand-pipes have been largely in the hands of the makers, and some are apt to be jealous of "engineers' notions." A certain uniformity of specifications in a general way would help in overcoming this tendency to resist new and better methods.

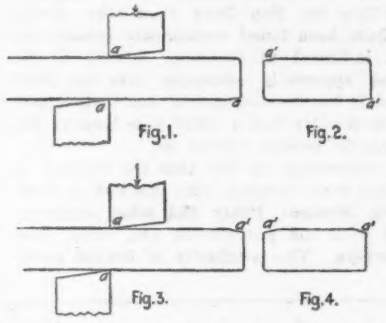
I will suggest a few points in which I believe there is room for improvement, and which I have not ventured to introduce into specifications as yet.

One is the method of joining the plates. The present method of lapping both horizontal and vertical seams is awkward and unmechanical, and belongs more to the methods of the village blacksmith than those of precise and scientific mechanism. They should rather be made like the accompanying sketch, taken from a paper read by the writer before the New England Water-Works Association in 1893. In this sketch the horizontal seams are lapped and the vertical seams made with butt straps. This is a perfectly precise method, and requires no beating down or drawing out of the plates, and, in my opinion, would really cost no more than the old way. I use it now on plates over ½ in. in thickness, but should prefer to use it on all thicknesses.

The most important element in stand-pipe construction, after that of proper material, is the riveting of the vertical joints, and of all the work that is done, this is the most discouraging and the most effective in preventing accurate design. Specifications require that the rivet holes shall coincide, but who has ever seen them do so, unless by that term is meant that a portion of one hole shall cover a portion of another? A drift pin is not allowed to be used (a very proper precaution), but it is not so very much better to chip out the hole and lose the metal, nor yet to force the hot rivet into a position where perhaps one-half its area is lost, as far as being effective in preventing shearing, which is the main duty of rivets in vertical joints.

I believe that the rivet holes should be punched smaller than the rivets; a ⅝-in. hole should be punched ½ in.. and other sizes in proportion, and when the plates are in position the holes should be reamed to the proper size, both holes together. This would make a beautiful job. The hole could be made just right for the rivet, and the joint would approximate the design in strength. Now, this would not increase the expense unduly if the shops were fitted up and accustomed to do this. The reaming could easily be done by power with the proper equipment, but it would require nerve to write the first specifications in this way.

The rivets should be driven by steam or hydraulic power. This may seem radical, but I do not think so. I see no real reason why it could not be done with the suitable appliances. If field riveting can be done by power in any structure, a stand-pipe is the best form, as there are continuous rows of rivets of about the same dimensions, and the only especial form of appliance would be the yoke of the riveter, which would need to straddle a 5-ft. plate. I do not believe this is impracticable. I think it must hurt the feelings of any engineer to see two men with heavy sledges pounding away at a cool rivet, endeavoring to form a head on it. The usual result is a very thin, flat head, as the rivets are used as short as possible in order not to cause too much trouble if they happen to get cold before they are finished.



Figs. 1-4. Effect of Shearing Soft Steel.

I fear that my letter is already too long, but I wish to say a word about painting. The plates should be cleaned of scale and covered with raw linseed oil before being exposed to the chance of rusting. They should not begin to rust. Before being sent to the site from the shop, they should have one coat of the paint which is intended to be used, all over them; the paint for the inside of the plates on that side, and perhaps the same on the outside, but no white lead or chemical paint should be put on the inside of plates. Pure asphalt paint or varnish cut with turpentine is good.

As to the quality of material, it is true economy to require the best, whether of iron or steel. As shown by Professor Pence's tables of present market prices, the difference in cost of tank steel and flange steel is only one-fourth of 1 ct. per lb., the latter only costing about 1½ cts. per lb., while the finished stand-pipe costs approximately 4 to 5 cts. per lb.

I believe the specifications of Professor Pence for material and workmanship are quite complete and suitable. I have been using similar ones for the past year, although not quite as complete, especially for the rivets and riveting, which are particularly good.

Yours truly, Freeman C. Coffin.

Boston, Mass., March 5, 1895.

Sir: I have read Professor Pence's specifications for stand-pipes in your issue of Feb. 28, and his remarks on the same, with a great deal of interest, and trust that they will be fully discussed as you suggest.

The only provision in these specifications for planing the sheared edges of plates is that "all calking edges must be planed to a bevel," and they do not require punched holes to be reamed in plates of under ¾ in. in thickness. This practice has the support of many engineers and manufacturers, but have we any thorough and extended series of tests to justify it? Would it not be much better to admit that all steel plates, no matter how soft the material may be, are injured by punching and shearing, and to thoroughly investigate the extent of this injury, than to go ahead, as we are now doing, without knowing very much about this matter?

The following is taken from my remarks in the discussion of Prof. Silas G. Comfort's paper on Bridge Specifications (Proc. Philadelphia Engrs' Club, November, 1894), and will show the extent and character of injury caused by shearing soft steel:

Here are three pieces marked 1, 2 and 3 from a ⅝-in. steel plate (which gave 53,180 lbs. ultimate strength—46% elongation in 2 ins. and 64.6% reduction of area). They were cut side by side from the plate. This material will bend all right, as shown by Sample 3, there being no cracks on either sheared edge. But Sample 1 is no good—it broke in two pieces; while in No. 2 one edge is good and the other poor. All these bends were made over a pin in same manner by slowly applied pressure.

If you will examine these pieces carefully you will find a depression on the rolled surface extending back about one-eighth of an inch from the sheared edge (the mark is the same as the mark of die in punching, only deeper). The metal here was in contact with the shear knife, a, Fig. 1, and has been compressed and hardened, and will not stand the bending test when on the outside of curve—that is, after being compressed it will not stretch. The rolled surface on the other side of plate at corresponding sheared edges is rounded, and will stand much better when on the outside curve. It is not the fine wire edge that causes the trouble, as you can remove it, and yet the plates will not stand bending.

Sample 2 was sheared in the usual way, as shown in Figs. 1 and 2; that is, after shearing one edge the plate was inserted a little further and a second cut taken, giving one compressed edge, a¹, and one rounded edge on each side of the plate; therefore you cannot get a good bend whichever side of the plate you have up.

In the other samples the plate was turned over after making the first cut, and both of the compressed edges brought on same side of the plate, Figs. 3 and 4. (This can also be done by turning the plate around, but it is hard to hold in shearing.) In Sample 3 both of the compressed edges were on the inside of curve, and the bend is good, while in Sample 1 they were both on the outside, and it is no good.

This, no doubt, is old to many of the members, but may be of interest to some of the younger members.

The samples of drifting tests had two ¾-in. holes punched in them, and one hole in each case has been enlarged to 1½ times its diameter, while in attempting to enlarge the other hole the plate in each case has broken at the edge. The poor results or failures were caused by using a drift with very slight taper—the metal would not stretch at sheared edge where it had been compressed and hardened. In the other cases a drift of much greater taper was used; it thickened the metal up around the holes; then a drift of less taper was used and the holes enlarged.

The sketches, Fig. 5, of these bent pieces, Samples 1, 2 and 3, and of the piece subjected to drifting, Sample 4, show fairly well the results of the tests.

Article 10 of Professor Pence's specifications reads:

Punching.—The work shall be carefully and accurately laid out in the shop, and the rivet holes punched with a center punch, sharp and in perfect order, from the surfaces to be in contact, etc.

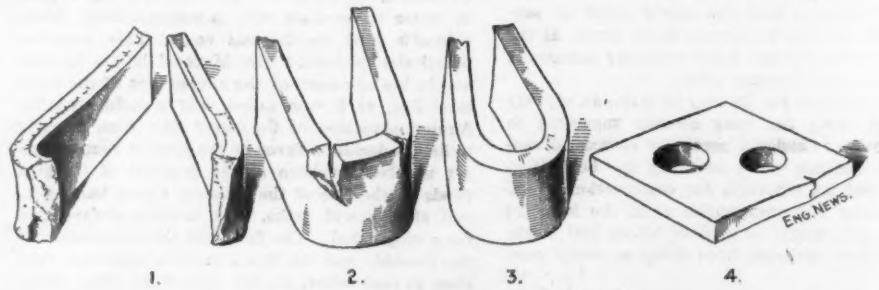


FIG. 5. SAMPLES 1, 2 3 AND 4.

This, as was stated, brings the bevel of the holes away from the surface in contact; that is, on the plates in outside courses the indentation made by the bottom die in punching (corresponding to the indentation "a," Figs. 1 to 4, in shearing) is on the outside of the curve, and in the very worst condition to withstand the action of the bending rolls.

In order to see how this would work out in practice, the following tests were made for me by Mr. S. M. Vauclain, Superintendent of the Baldwin Locomotive Works:

Two pieces of open-hearth steel boiler plates, ⅝ in. thick, were sheared to 6×24 ins., the plates being sheared in the usual manner, giving in each one longitudinal edge rounded, and the other with depression, "a," Figs. 1 to 4. Two lines of .5-32-in. holes were punched with 2-in. pitch, centers 1½ ins.

from edges of plates. One-half of these holes were punched from one side of the plates, the plate turned over and the balance of holes punched. This gave in each plate the conditions of punching of both outside and inside plates in a stand-pipe. As these plates were to be bent, they were marked near the holes "punched from inside," or "punched from outside," corresponding with proposed manner of bending.

The edges of one of these plates, Sample 6, Fig. 6, were planed and all the holes reamed; those punched

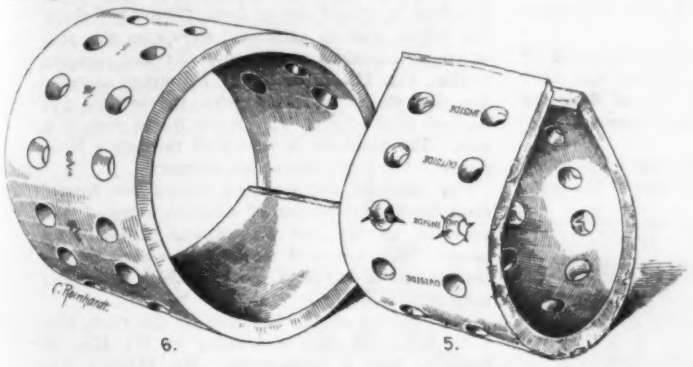


FIG. 5. SAMPLES 5 AND 6, 5-8-IN. OPEN-HEARTH STEEL BOILER PLATE.

from the inside were reamed 1-16, and those from outside 1/8 in. Both pieces were then bent in bending rolls to a curve, 16 ins. in diameter; neither showed any cracks at holes or edges of plates. They were then closed down under a hydraulic press to a circle of 8½ ins. diameter, as shown in Fig. 6. Sample 6, with reamed holes and planed edges, did not show any cracks at either edges or holes, but Sample 5, with sheared edges and punched holes, cracked at all holes punched from the inside, and at several places along the sheared edge "a," Figs. 1 to 4, but none of the holes punched from the outside cracked.

Two pieces of Bessemer steel plate, ½ in. thick, were sheared to 6×36 ins., and punched the same as before. They are shown by the sketch, Fig. 7. Sample 7 has sheared edges and punched holes, while Sample 8 has planed edges and reamed holes. These pieces were bent in bending rolls, but when Sample 7 reached a curve of 20 ins. diameter, the plate had cracked in four places from the sheared edge "a," Figs. 1 to 4, to the punched holes. In three cases the holes were punched from the inside, and in the fourth from the outside. In the last case the crack no doubt started from the edge of the plate, as none of the other holes punched from the outside cracked at all.

Sample 8 was bent to a curve of 20 ins. diameter on bending rolls, and then forced down under hydraulic press to a curve of 8½ ins. diameter, without showing any cracks in the metal at the reamed holes or planed edges.

The tension tests and analyses of this material are shown in the accompanying table:

Tension Tests and Analyses of Test Plates Nos. 5, 6 and 7.

	⅝-in. open-hearth steel plates,		12-in. Bessemer steel plates,
	No. 5.	No. 6.	Nos. 7 and 8.
Elastic limit, lbs.....	34,180	32,700	31,000
Ultimate strength, lbs.	61,200	60,900	60,880
Per cent. stretch, lbs..	28.87	29.12	21.87
Carbon	0.22	0.21	0.18
Manganese	0.39	0.47	0.46
Sulphur	0.037	0.014	0.040
Phosphorus	0.017	0.014	0.112

The Bessemer steel plate contains much more phosphorus than the open-hearth steel, but no more than some of the steel used in stand-pipes.

If we take into consideration the results of the bending test on Plate 7, and the drifting test 4, it is not a very hard matter to build up a theory of the cause of some stand-pipe failures. But this is not the question. It is, how to guard against these failures in the future. I would respectfully submit the following:

That in all stand-pipe work the sheared edges of steel plates should be planed before the holes are punched, as small cracks are often started at the sheared edge by punching (same as by drifting, Sample 4). These cracks may not be removed by subsequent planing of the edge, and would be enlarged when the plates are bent in the rolls. I know that it is a little more convenient to punch the plates first, and then set them at the planer by passing two of the punched holes over pins, and then planing off the edge. This practice is not uncommon, but a few experiments on this point will convince any shop superintendent that he can get better results by planing the plates first.

The same plan of working holds good for punching and reaming, even when the edges of plates have been planed first. This work should all be done in the following order: Plane edges, punch holes, ream holes, and then bend plate. But it is not at all uncommon, even in boiler work, to carefully plane the edges of steel plates, punch holes, bend in rolls, assemble plates, and then ream. The above experiments show how much better it would be to ream the holes before bending, even if some additional reaming had to be done after assembling.

Yours truly, Wm. R. Webster.

3310 Hamilton St., Philadelphia, March 30, 1895.

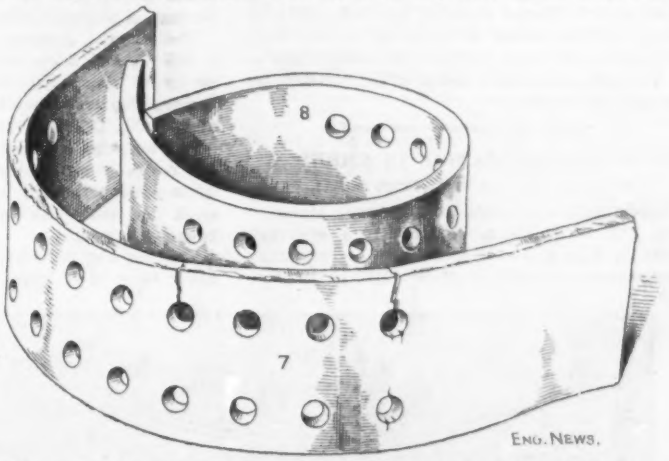
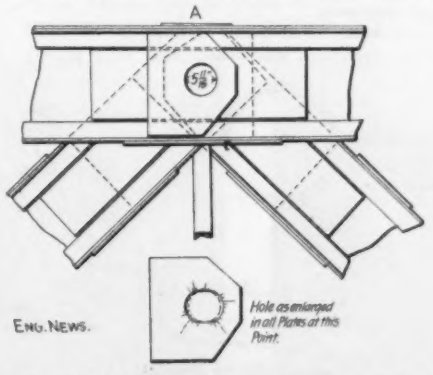


FIG. 7. SAMPLES 7 AND 8, 1-2-IN. BESSEMER STEEL PLATE.

PIN-CONNECTED WARREN TRUSSES FOR SHORT-SPAN BRIDGES.

Sir: There have recently come to my notice two cases of Warren truss bridges in which there was a rotary movement at the center top chord pins, increasing to such an extent as to soon render the spans actually unsafe. In one case the pin worked entirely out, I am told, and dropped to the ground, one or more trains passing over the structure after this had occurred. The posts bearing against the tie plates on the chord, with the stringers, carried the load over two panels. In the other case, which I myself saw, the pinhole had worn and been battered until it was ¼ to ⅝ in. larger than its original size. The edges were badly battered also, as would be expected.

These two spans were on different roads, located in widely different parts of the country, and were made by different builders. The material examined was good, though rather soft, and there is no reason to doubt that the workmanship was up to the average.



Panel Joint of Warren Truss, Showing Enlargement of Pin Hole.

The bearing surfaces, as usually determined, were ample, and I think the trouble was not due to any misfit or faulty material, but to the sharp reversal of strains, greater at this joint than elsewhere in the span. The pin in each case could be seen to travel around as the bearing surface changed by the engine passing from one side to the other. After the hole had worn a little the result was, of course, a heavy blow, rapidly increasing in effect as the hole was more and more enlarged. I wonder if other engineers have found this same trouble, and to what extent? It would not require much such evidence to condemn this type of bridge for short railway spans subject to heavy reversals of stress. It might show also that such reversals were a good thing to avoid wherever possible. Respectfully, C. H. Wright.

Wilmington, Del., April 17, 1895.

RECENT PAVING BRICK TESTS—CORRECTION.

Sir: Bricks Nos. 3 and 4 in the paving brick tests, that you published on April 18, under the above title, should be marked "Ohio pavers, name in dispute." The paper labels by which they were marked were lost in making the absorption test, and it appears that they were incorrectly copied. The Shale Brick Exchange, of Canton, O., and the Malvern-Carrollton Paving Brick Exchange both claim these sample bricks as of their manufacture.

Yours truly, Harvey Linton, City Engineer.

Altoona, Pa., April 25, 1895.

THE TENNESSEE RIVER IMPROVEMENT.

A contributor to "Harper's Weekly" has been looking up the progress and cost of government work on the Tennessee River improvements, and the result is about as follows:

The first survey in this region was made in 1828, and in 1830 Congress voted 400,000 acres of land in Alabama to be applied principally to the improvement of the Muscle and Colbert shoals. In 1831 the state of Alabama took up the work, and in 1836, after an expenditure of $700,000, opened to traffic a canal 14½ miles long, 60 ft. wide and 4 ft. deep around these obstructions. There were 17 locks, 120 ft. long between sills, 32 ft. wide and with an average lift of 6 ft. each. But this canal proved of little value, as other obstructions interfered with navigation above and below, and in 1837 the canal was abandoned and remained so for 40 years thereafter.

In 1867 new surveys were made from Chattanooga to the Ohio River and extensive improvements were recommended. In 1875, a second Muscle Shoals canal was commenced by the national government. The new plan called for a canal 16 miles long, from 70 to 120 ft. wide at the water surface and 6 ft. deep. There were to be 11 locks, with an average lift of 10 ft. each, and Shoal Creek was to be crossed by an aqueduct of iron girders, 860 ft. long in all. This canal was opened to navigation on Nov. 10, 1890, after a total expenditure at the shoals of $2,817,341.

The writer then figures up the traffic on this canal and concludes that the government has paid a somewhat extravagant price for the privilege of handling this freight. According to the figures of Mr. C. W. Robinson, the author in question, the total traffic of 1892-'93 through the canal was 8,391 tons. Allowing only 3% on the total expenditure, or $84,520.23, and adding to this $65,000, the annual charge for maintenance, he finds a total annual charge of $149,520.23. This divided by the 8,391 tons of freight gives a transportation cost to the government of $17.81 per ton, far exceeding the gross value of the load carried. If to this $17.81 is added the cost of work above this point in the river, the total cost per ton for transport would be about $25 per ton.

The writer charges this extravagance to the "geographical distribution of the funds in our River and Harbor bill; a system which has too long prevailed in the periodical division of spoils among Congressmen. As an instance of the utter absurdity

of some of the expenditures, he quotes from the last appropriation bill, one item recommending a preliminary examination to be made of the Okanogan River, in the state of Washington, "from mouth to head of nagivation." Mr. Robinson declares that he is very familiar with this river; has walked over it, almost dry-shod, one mile above its mouth, and has ridden his pony up its bed from the mouth to its very source. Its total length is not 75 miles, and not a dozen white families reside upon its banks.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 144.—With inset.)

Intermittent Filtration at Brockton, Mass.

The city of Brockton constructed a sewerage system in 1893-4 which does itself, its sewerage commissioners and city engineer, Mr. F. Herbert Snow, great credit. The sewage is brought through a main outlet to a receiving reservoir, from which it is pumped to filter beds and purified by intermittent downward filtration. The most available site for the disposal area presented a variety of material. This was studied in detail both before and during construction, and a record kept for each bed. Means have been provided for determining the work done by different kinds of filtering material, and the best methods of applying the sewage in point of frequency and amount. The whole design of the works and the lines along which Mr. Snow proposes to operate them promise results which will be satisfactory to the people of Brockton and instructive to all interested in sewage purification.

FIG. 111. VIEW OF RECEIVING RESERVOIR DURING CONSTRUCTION.

Brockton is a shoe-manufacturing city, located a short distance from Boston, Its population in 1890 was 27,294, having increased almost exactly 100% in ten years. Water-works were built by the city in 1880-1, but the separate system of sanitary sewers was not put in operation until late in 1894.

The water consumption is notably low, largely owing to the use of meters. For the year ending Nov. 31, 1894, the average daily consumption per capita, assuming 30,000 population, was only 24.3 gallons, the highest figure being 39.4 gallons as the average for June, and the lowest 18.7 for March. In designing the sewerage system allowance was made for a daily consumption of 60 gallons per inhabitant and 500,000 gallons daily of leakage into the sewers.

The main outlet sewer to the receiving reservoir is of brick, egg-shaped, varying from 26 × 39 to 32 × 48 ins. in size, and about two miles long. A sub-drain of 6 to 15-in. Portland pipe was laid beneath the sewer. On the sizes up to 12 ins. the joints were wound with cheese cloth. The joints of the 15-in. drain were tamped lightly with jute. Around and about 1 in. above the pipe gravel was packed, and on top of this bagging was placed to separate the finer material from the gravel. The estimated leakage into the two miles of brick outlet sewer, when water is at its usual height, is about 120,000 gallons a day; in time of floods the leakage is probably 350,000 gallons.

The covered masonry receiving reservoir is 42 × 118 ft., and when full to overflowing has a capacity of about 500,000 gallons. Its design and construction are shown by Figs. 1 to 3 on the inset and by Fig. 111 in the text.

The material encountered in the construction of the reservoir gave some difficulty, but not until after passing through about 10 ft. of fine, dry sand. At about this depth ground water and clay began to appear.

Two rows of 3-in. matched sheeting were driven about 10 to 12 ft. apart, one each side of the main walls, the enclosed material removed, the walls built, and then the excavation inside the walls continued to completion. At one point 4-in. sheeting was necessary. For bracing 12 × 12-in. yellow pine was used.

To stop some troublesome springs in the bottom of the reservoir, pine board plugs were placed well down into the 10 and 12-in. vitrified pipe through which the springs were discharging, 2½-in. iron pipes being provided to carry off the water. The vitrified pipes above the plugs were then filled with cement, allowed to set, and finally the 2½-in. pipe were capped, effectually stopping the flow.

The course of the sewage from the gate chamber through the reservoir to the screen chamber, and the general arrangement of the reservoir and accessories, are shown by Figs. 1 to 3 on the inset. The screens have been built, as shown in Fig. 3, to facilitate cleaning, the attendant stepping down onto the grating to rake off the lower section when the chamber is only partly full. The screens are made up of flat pieces of iron ¾ ins. apart. The sludge chamber is 4 ft. deeper than the reservoir, and is designed more especially for future use. For the present the sludge at the bottom of the reservoir is stirred up by back pumping through the "10-in. pipe to agitator," shown on the plan of pipe connections at the reservoir and pumping station, Fig. 112, in the text. By means of agitation the sludge is mixed with the sewage and pumped to the beds. The device works well, it is said. The reservoir is ventilated through a 15-in. pipe and the main flue of the chimney.

The reservoir and pumping station are located upon the highest portion of some six acres of land acquired by the city for sewage disposal purposes. The excavated material was used for filling in some of this land, most of which is low and subject to flooding.

The pumping station is shown by the view, Fig. 113, reproduced from a drawing by Mr. Geo. B. Hancox, from a photograph. Mr. Hancox was draftsman for the sewerage system. The engine room is 44 × 53 ft., and the boiler room is 38 × 42 ft. Coal is stored in a separate building. The chimney foundation consists first of 2 ft. of Rosendale concrete 22 ft. in diameter, resting on fine sand, then 6 ft. of rubble masonry 20 ft. in diameter at the bottom and 14 ft. at the top. The settlement caused by the chimney is given by Mr. Snow as ⅝ in. There are two 5,000,000-gallon triple compound condensing Knowles pumping engines. The station is heated by steam and lighted by electricity.

The force main is of 24-in. cast iron, 16,643 ft. long and rises 34.5 ft. to the terminal chamber. By closing the gate on a 24-in. outlet from this chamber the sewage may be raised 4 ft. higher and conveyed through another outlet of similar size to supply another set of beds. Six plugged branches have been provided, so that, if desired, sewage can be drawn out for irrigating farm land along the force main.

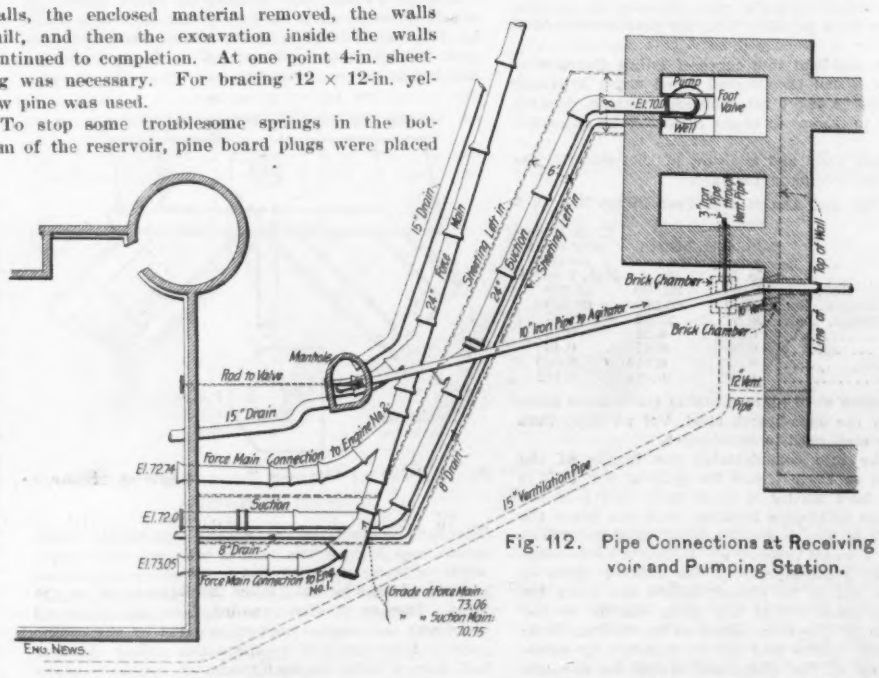


Fig. 112. Pipe Connections at Receiving Reservoir and Pumping Station.

The filtering area comprises some 30 acres, laid out in 23 beds, as shown by the plan, Fig. 4, on the inset sheet. A portion of this area was covered at the time the land was secured, and most of the balance had been covered previously by a heavy second growth of white pine, as may be seen by the view in the text, Fig. 114. The pine woods beyond the beds are also shown in the view, Fig.

115. This view includes one corner of the disposal area, and was taken before the beds were completed.

Geologically the disposal area is a part of a comparatively limited sand deposit at the foot of a hill. A thin stratum of clay occurs about 8 ft. below the surface. This probably separates, Mr. Snow states, the sand and gravel deposited by the water from that brought into place by the wind. Above the clay the stratification is generally level and horizontal; below it is in all conceivable directions and dips, the material varying in size, but generally blending together gradually.

Gagings of ground water during the latter part of 1893 and most of 1894 show a variation of

FIG. 113. VIEW OF PUMPING STATION. From a Drawing by Geo. B. Hancox, after a Photograph

from 2 to 4 ft. from the higher to the lower portions, the water rising and falling about equally over the area. In a well typical of those tested, the water was at its highest point, 99.09 ft., on May 13; it dropped 1.28 ft. during the next month, 0.97 during the next following and 0.58 ft. per month for each of the succeeding months, standing at 95.17 on Oct. 12, against 94.70 on Oct. 31 of the previous year. Nov. 12 it reached its lowest point during the winter 1893-4, 95 ft., which was almost 0.5 ft. above its elevation at the corresponding date the previous year. The rise from Oct. 31, 1892, to May 13, 1893, was 4.39 ft. The rainfall of 1893 was 7.3 ins. more than that of 1892. The average level of the ground water is about 3 ft. below the stratum of clay.

Before beginning construction, the character of the material in its natural position was approximately determined by means of 80 test pits. From these pits about 400 samples were taken, placed in 4-oz. bottles, classified and labeled. The material encountered was classified as shown in the accompanying table, which also gives the results of physical analyses made by the Massachusetts State Board of Health.

Classification and Physical Analyses of Material at Site of Brockton Filter Beds.

Classification.	Diameter in millimeters. Effective size.*	Uniformity co-efficient.**
Clay	0.010	...
Quicksand	0.036	2.5
Subsoil	0.070	5.0
Sand: Very fine	0.090	2.1
Fine	0.300	2.0
Medium	0.410	2.3
Coarse	0.600	4.2
Very coarse	0.760	4.5

* 10% of the total material finer than this.
** The quotient of the effective size into the size of the material at the 60% point.

The State Board of Health advised that the subsoil, with the composition given in the table and 1% of organic matter, might be used for a time, provided there was no disturbance of the natural

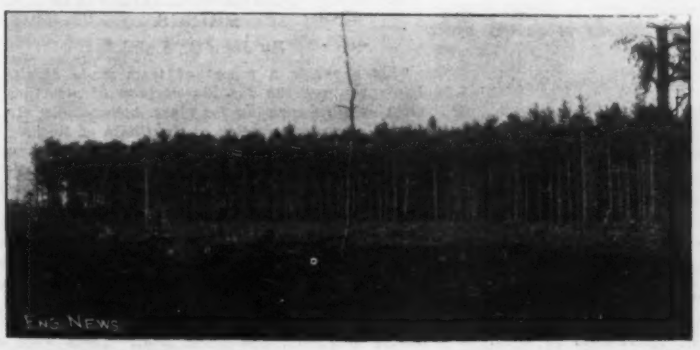


FIG. 114. PORTION OF FILTERING BEDS BEFORE BEGINNING WORK.

FIG. 115. PORTION OF FILTERING AREA AS THE BEDS WERE NEARING COMPLETION.

The natural material at the site of the filter beds was not disturbed except at the surface. On twelve beds the subsoil was stripped to the sand, on five a thin layer of subsoil remains and six have surfaces partly of sand and partly of subsoil.

layers by which it grades into the underlying sands. It was originally intended to remove the subsoil from only seven beds, but the tendency of this material to pack, and the low price for which it could be removed, led to the construction indicated above. The depth of loam averaged 9 ins., and of subsoil 2 ft., both being very uniform over the whole area.

Generally the coarser sand is at the top, but there is great variety in the formation, as may be seen by the two sections across Bed No. 4, Fig. 116, which is by no means an abnormal showing. Fortunately the different materials have been sifted into one another, so that the change in size is gradual. Otherwise only poor results could be expected, judging from the Lawrence experiments. Regarding the effects of stratification, the engineer for these works, Mr. Snow, has written as follows in his forthcoming annual report for 1893-4:

> Stratification, either natural or created by conditions brought about in the working of the filter, is the explanation of almost all the failures in filtration.
>
> The capacity of a filter composed of sand, stratified in well-defined layers, is less than the capacity of the poorest continuous layer of sand in the filter. The extent to which the capacity will be limited depends upon the difference in size of grain of adjacent layers. A fine sand above a coarse remains saturated from the low capillarity of the coarse sand, and consequently prevents air from entering the underlying material. Sewage may be forced through under a head, but no purification can take place without air. This is the condition presented by a filter when the surface is clogged by organic matter. A fine sand beneath a coarse becomes clogged with that portion of the organic matter of the sewage which is too fine to be caught by the upper layer. Practically, a portion of the mechanical screening which the surface layer usually performs is done by the fine layer. The consequent clogging is much worse than it at the surface, because the supply of oxygen is less plentiful and the deposit cannot be removed by raking.
>
> However, as stated above, it is believed that, except in the case of the irregular pockets and thin streaks, the layers graduate evenly into one another and the evil effects of stratification will not be felt.

Besides conveying an idea of the material composing the beds, Fig. 116 is designed to show the graphical method employed by Mr. Snow in recording the material encountered in digging the underdrain trenches. This record supplements that obtained from the test pits, mentioned above. The original from which this illustration was made is one of 23 sheets, one for each bed, drawn on a large scale on heavy Whatman paper.* The classification here was by the eye instead of physical analysis, which obviously would have been very expensive, but the same assistant made all the observations, and they may be considered as approximately correct.

In constructing the beds the average excavation did not exceed 3 ft., but the loam, subsoil and sand had to be moved separately. All second handling of loam was at the expense of the contractor.

The large embankments are 18 ft. wide on top, and are carried 5¼ ft. above the grade of the main distributing pipes, as is shown in Fig. 7. The small embankments are 9 ft. wide on top and 2 ft. higher than the beds. All embankments were built in thin layers, a three-ton grooved roller supplementing the packing caused by the teams. The embankments were carried to within 6 ins. of subgrade, or the bottom of the 12 ins. of loam finish, before the distributing pipes were laid, thus making necessary trenching and back-filling. This was done to ensure a true grade for the pipes.

The force main ends in a brick gate chamber at elevation 106½ ft. Two 24-in. distributing mains lead from this chamber, one at the elevation named, and the other at 110 ft., the latter going west. The lower pipe is provided with a gate, to raise the sewage to the upper level.

Gate chambers are placed at all changes in the

* The original drawings were in ink spatter work, with the clay washed with a blue and the subsoil with a brown tint. The drawing from which Fig. 116 was reproduced was mostly crayon work, redrawn from the original for use here.

alinement of the distributing pipes. All these chambers have 8-in brick walls and their corners rounded to prevent deposits, as shown in the details of the distributing chamber, Fig. 8. The gates were made by the Coffin Valve Co. They are of cast iron, with flanges enclosing the brickwork, and without bolts. The screw rods of the larger gates are stationary, and those of the smaller ones can be telescoped down so that in either case nothing projects above the ground, all as shown in Fig. 8. The gate chamber covers are of white pine.

The pipes from the distributing chambers to the beds are shown in Fig. 7. Some are 12 and others as shown in Fig. 9. In the manhole on the 15-in. underdrain, at Pearl St., just outside the beds, is also a weir, as shown in detail in Fig. 10. The movements of the float connected with this weir are transmitted electrically to the office of the city engineer. The plan, Fig. 4, shows that the effluent from ten thoroughly underdrained beds will flow over this weir, in addition to which there will be some effluent from bed No. 1, less from No. 2, perhaps a little from No. 3 and some ground water from the 8-in. drain.

Besides affording a means of measuring the underdrainage, Mr. Snow states, the manholes will admit air to the lower part of the beds. The whole

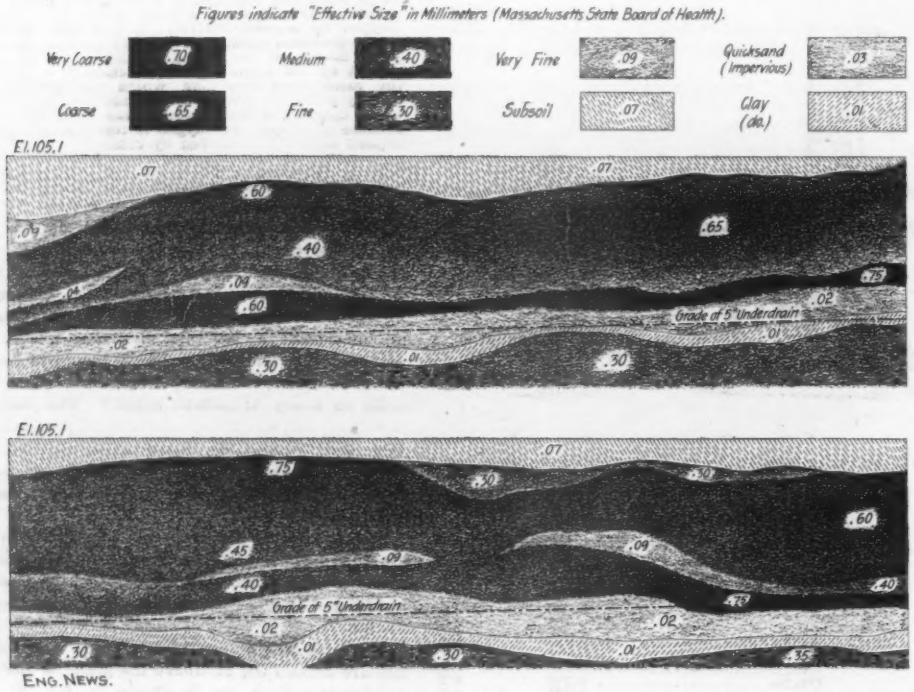


FIG. 116. FORMATION OF MATERIAL IN FILTER BED NO. 4, ON LINES OF THE UNDERDRAINS

15 ins. in diameter. The ends of the pipes are protected by masonry abutments, and enter the beds about 0.5 ft. above the surface of the latter. The combined carrying capacity of these sub-distributing pipes is 7.7 cu. ft. per sec., the full estimated flow of sewage.

The carriers are designed to prevent one of the disadvantages under which many large filter beds work, namely, imperfect distribution of the sewage over the whole bed. The carriers are of wood and cost about $1.50 each. They are flat-bottomed sluiceways, diminishing by offsets of 6 ins. on a side from a width of 5 ft. at the upper to 1 ft. at the lower end. Platforms are placed beneath the carriers at these side outlets. This decrease in width maintains the depth and velocity of flow in the carrier, and the openings being in the direction of the current there is less retardation of flow and cause for deposit than where the sewage is taken off at an angle. Mr. Snow, naturally, objects to wood for carriers, as well as for covers to the gate chambers, and would have preferred curved to flat-bottomed carriers. The grade would not permit the latter in all cases, and economy was a governing principle in the use of wood.

Before beginning construction only two underdrains were included in the designs. These were to have been laid near the level of the water table. A continuous layer of impervious clay, from 7 to 8 ft. below the surface of the beds and about 3½ ft. above the water table, having been found in beds Nos. 4 to 13, inclusive, lateral underdrains were put down, as shown in the plan of the beds, Fig. 4. The 5-in. laterals in each bed, laid some 60 ft. apart, are above the clay, and the 8-in. main connecting the manholes in beds Nos. 9, 10, 11, 12 and 13 is laid at the lower level, as shown by Fig. 9. Weirs are provided in the small manholes, pumpage can be concentrated on one or more of these underdrained beds, and the resulting effluent determined whenever desired.

The brook just at the right of the beds, Fig. 4, was straightened, as shown, and a weir, Fig. 5, with self-recording instrument, Fig. 7, placed in it.

The cost of the disposal works is shown by the accompanying table.

Cost of the Brockton Sewage Disposal Works.

Receiving reservoir and foundations for pumping station and chimney	$29,864	
Pumping station and chimney above foundations, gate and screen houses	16,991	
Pumping plant	23,649	
Engineering and inspection on above	2,736	
Sundries on above	2,007	
		$75,247
Force main		74,989
Disposal area		59,536
Total cost disposal works		$209,772

The main items in the cost of the disposal area were 3,046 sq. yds of grubbing, at $2 per yd., $6,093; 8,583 cu. yds. of excavation in beds, at 23 cts. per yd., $19,739; 24 to 5-in. vitrified pipe for distributing sewage and underdraining beds, trenching for and laying same, $12,631; land damage, $9,234; sundry items make up the balance.

We are indebted to Mr. F. Herbert Snow, City Engineer of Brockton, for the material from which this article and its illustrations have been prepared. Much of the text has been abstracted from Mr. Snow's forthcoming report on this work, which will be full and valuable. Mr. Snow's principal assistants have been as follows: In general charge of sewer work, Mr. Chas. R. Felton; in charge at filter beds, Mr. Frank A. Barbour; in charge of construction of reservoir, pumping station and plant and force main, Mr. John S. Johnson. Mr. Wm. M. Douglas is chairman of the sewerage commission.

STAND-PIPE ACCIDENTS AND FAILURES.

(Concluded from p. 287.)

from cases of serious damage to seemingly unimportant incidents. Special interest attaches to the total failures. These are reclassified in Table XII.

Of the 23 cases of total failure, two were due to defective masonry or foundation, seven were elevated wooden tanks, and in one case the stand-pipe was demolished by overturning. The remaining 13 cases of total failure either originated in, or were accompanied by, plate fracture. For this reason they are of special interest in contrasting the two metals used in their construction. Table XII. presents a classification of these cases, which may not be entirely without value in considering the relation between quality of plate metal and period of development. Three of these 13 failures occurred previous to the year 1886, one each during the years 1886, 1887, 1890, 1891 and 1895, three in 1893 and two in 1894. Tracing existing conditions and probable cause, it is found that 6 of the 13 total failures occurred under simple hydrostatic pressure, two under wind action and five in the presence of ice. Of the last-named cases four have taken place since 1890. Referring to the 10 cases of total failure which are not included in Table XII., it will be seen that in no case has the date, either of construction or failure, fallen prior to the year 1885.

TABLE XII.—Special Classification with Reference to Date of Construction and Kind of Metal in the Cases of Thirteen Stand-Pipes Whose Total Failures were Due to or Accompanied by Plate Fracture.

Year built.	Steel.	Wrought Iron
1859	.	1
1868	.	1
1881	1	.
1886	2	.
1887	2	.
1889	1	.
1890	2	.
1893	1	.
Total, 12	9	2

There is no evidence that stand-pipe accidents are on the decrease, and with the number of stand-pipes continually increasing, it seems very certain that accidents of more or less severity will continue to occur. Their frequency, in the future as in the past, will in a degree depend upon the severity of meteorological conditions, but the fact cannot with reason be disputed that a very considerable diminution in the number of such accidents might be effected by proper care on the part of those who are directly responsible for the design, construction and also the subsequent use of the stand-pipe.

TESTS OF NON-CONDUCTING PIPE COVERINGS.

By John A. Laird.*

This paper is a report of tests made at the St. Louis water-works for the purpose of selecting the most suitable covering for pipes, boiler-shells, etc., in the new pumping station at the Chain of Rocks. The specifications for the engine and boiler work called for a covering satisfactory to the Water Commissioner, and, not having any data at hand which seemed to be perfectly satisfactory, we concluded to give the different coverings a comparative test under conditions as nearly uniform as possible. For this purpose there were purchased asbestos sponge molded sectional covering, asbestos fire-felt sectional covering, and magnesia sectional covering, all for 1-in. pipe. Also, asbestos sponge cement felting, asbestos cement felting, plastic magnesia, and fossil meal. Tests were also made on plaster of Paris and sawdust, molded into covering for 1-in. pipe. The different coverings were subjected to chemical examination by Mr. Wixford, chemist of the water-works, with the following results:

	P. ct.
Asbestos Sponge, Molded.	
Plaster of Paris	95.8
Fibrous asbestos	4.2
Asbestos Fire-Felt.	
Asbestos	82
Carbonaceous matter not determined	18
Magnesia (Sectional).	
Magnesia	92.2
Fibrous asbestos	7.8
Magnesia (Plastic).	
Magnesium carbonate	93
Fibrous asbestos	7

* Abstract of a paper read before the Engineers' Club of St. Louis, and printed in the January number of the Journal of the Association of Engineering Societies.

Asbestos Cement Felting.

	P. ct.
(Probably) Powdered limestone	64.5
Plaster of Paris	3.5
Asbestos	32

Asbestos Sponge Cement Felting.

(Probably) Powdered limestone	59
Plaster of Paris	10
Asbestos	31

Fossil Meal.

Insoluble silicate	80
Carbonaceous matter, hair, paper, sawdust, etc.	12
Soluble mineral matter	8

The chemical analyses were approximate, and were intended only to give some practical idea as to the composition of the different coverings.

The tests were only comparative, and the apparatus consisted of two 1-in. pipes about 24 ins. apart, connected at one end to a transverse steam pipe and set at a slight incline, with a cock at the lower end. The pipe was first put together and tested. All connections, valves and fittings were then covered with 1 in. of plastic magnesia. When this was dry it was covered with 1 in. of hair felt, bound on with twine. There were left bare on each line 10 ft. of 1-in. pipe, to which the coverings to be tested were applied. All the coverings tested were 1 in. thick.

Before beginning a test, steam was allowed to blow through the pipes for some time. Two independent methods of comparing the insulating properties were used. First, by measuring the water condensed in a given time; second, by closing the steam valve and drain cock on each pipe and noting the reduction of pressure in the pipe by a gage at intervals of one minute. On all condensation tests the gage pressure was held at 25 lbs. The water was drawn off every 15 minutes and was measured in cubic centimeters. Each test was continued for four hours. The mean results are tabulated below.

Condensation Tests.

Name of covering.	Cu. c. condensed per hour.
Magnesia (plastic)	334.0
Magnesia (sectional)	335.3
Asbestos fire-felt	367.5
Asbestos sponge, molded	371.3
Fossil meal	376.2
Plaster of Paris and sawdust	438.0
Asbestos fire-felt cement	563.7
Asbestos sponge cement	604.0
Bare pipe	1,085.0

On all pressure tests the gage pressure was made 25 lbs. at the beginning. Four tests were made of each covering. Both methods show that the magnesia plastic and sectional coverings possess the best insulating powers. molded, the difference is 3½ grams per ft. of 1-in.

Both methods show that the magnesia plastic and sectional coverings possess the best insulating powers. Compared with the asbestos fire-felt and sponge molded, the difference is 6½ grams per ft. of 1-in. pipe per hour. There will be the equivalent of 6,000 ft. of 1-in. pipe in engine and boiler houses at Chain of Rocks, and it is estimated that by the use of magnesia instead of asbestos covering there would be a saving of 1,134 lbs. of water and 189 lbs. of coal per day, or equivalent to $47.20 per year.

A question which naturally arises, in a comparison like the above, is that as to the durability of the coverings, and I will say that the magnesia sectional covering, which has been on pipe at Bissell's Point for four years, shows no signs of deterioration; also that the asbestos sponge molded covering, which has been on pipes at Harlem Creek for less than two years, is becoming soft and the plaster of Paris seems to be reduced back to the original powder, with nothing but the fibrous asbestos to hold it together. After giving the matter considerable attention and thought, he has no hesitation in recommending the magnesia covering, sectional and plastic, as the best insulation in the market.

A HELIOTROPE FLAG FOR ENGINEERS.

By Walter C. Parmley, First Assistant City Engineer, Peoria, Ill.

Having experienced the usual difficulty in seeing the ordinary flags or lining rods at long ranges, in 1891 I designed the heliotrope here illustrated. Subsequent experience in carrying out accurate street alinements has so demonstrated its utility that I now make it public for the benefit of the profession. Its practicability as an instrument for ordinary field use will appear from the fact that it works on an ordinary lining rod, can be quickly and accurately centered over any transit point and is readily operated by any intelligent rodman.

Fig. 1 shows the heliotrope on a ⅝-in. round lining rod, and turned in a position to illustrate its construction, while Fig. 2 shows it in the position in actual use. The instrument consists of a substantial brass arm, A, finished to a semi-circle 2¼ ins. in diameter and ⅜ in. square in cross section. The shoulder (B) widens out and is provided with a ⅞-in. hole, permitting it to slip up and down the rod, and is clamped in any position by the screw c. A steel point (D) is threaded permanently into the shoulder, which, with the pointed screw, E, supports a brass ring (F) 1¾ ins. inside diameter and 3-32 in. × 7-32 in. in section. Inside this ring a brass plate ⅛ in. thick and 1 3-16 ins. square turns upon the pointed screws G G. This plate carries upon its face a circular mirror 1 in. in diameter. At the center of the mirror the silver is cut away in a round spot 1-16 in. in diameter, and this spot sets over a small beveled hole through the square brass plate. The mirror being thus mounted in gimbals can be rotated into any position without changing the position of its center.

To direct this beam of light in the required direction, a thin brass screen (H), provided with suitable openings, fitted with fine cross-wires, is mounted, as shown, upon the strong spring-wire frame (I) at a distance of 8 ins. from the mirror. This frame is sustained in any position by the friction of the conical ends (J J), fitting into holes in

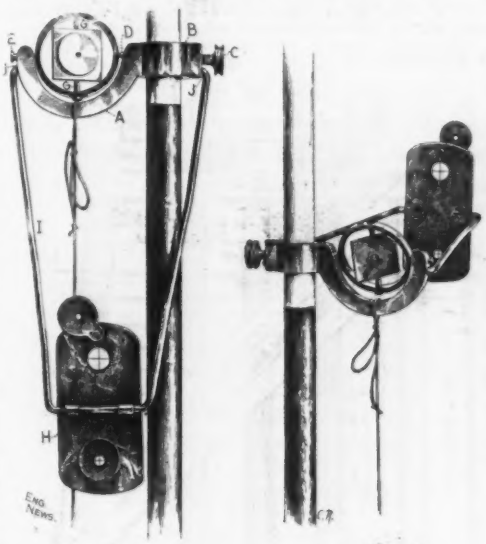


Fig. 1. Fig. 2.

A Heliotrope Flag for Engineers.

the arm and shoulder. The screen is provided with four different-sized openings by the use of two revolving shutters. One of these shutters is shown turned aside. The openings thus provided are respectively ⅛, ¼, ½ and ¾ in. in diameter, and the appropriate size is used according to the distance and brightness of the sun. The method of use is as follows:

The heliotrope is set in the position shown in Fig. 1, and the rod planted in the ground a few inches to one side of the tack point. With the plumb line sustained as shown, the rod is leaned till the bob is exactly over the tack and the vertical line passes through the center of the mirror. The screen is then raised until, by looking through the center of the mirror, the cross-wires range with the position of the distant transit man. The mirror is then rotated into the sun till the beam of light is centered upon the cross-wires. The flash is then visible to the transitman. With a little experience only a few minutes are required to set up and throw the light in any desired direction.

The penetration of the sun's ray is truly wonderful. With the ¼-in. diaphragm I have very clearly seen the light with the naked eye through three miles of dusty city street, when a load of hay at a less distance was not visible even in the telescope. One of my friends has made practical use of the ⅛-in. shutter on 6-mile ranges, and another required only the ¼-in. opening for a 16-mile range.

I have found the instrument so useful that I do not see why our supply houses should not be able to place some such instrument upon the market. In your issue of March 3, 1893, p. 311, you illustrate a form used in the resurvey of St. Louis. The form there shown will accomplish similar results, but it is not so convenient a mounting for ordinary field use.

LEGAL ELECTRICAL UNITS IN THE UNITED STATES.

The units of electrical measure recommended by the International Electrical Congress, held at Chicago in 1893, was officially adopted by the U. S. Office of Standard Weights and Measures, with the approval of the Secretary of the Treasury. While this action affected all government contracts in which electrical measures were involved, it was in no way binding upon state, municipal or private operations. To remedy this deficiency, the law given below was passed by both houses of Congress and signed by the President, and became a law on July 12, 1894. It supercedes all previous action in the matter, and substantially agrees with the recommendations of the International Congress. The specifications referred to in Section 2 have not yet been prepared by the National Academy of Sciences, but are expected shortly:

An Act to Define and Establish the Units of Electrical Measure.

From and after the passage of this Act the legal units of electric measure in the United States shall be as follows: (1) The unit of resistance shall be what is known as the international ohm, which is substantially equal to 1,000,000,000 units of resistance of the centimeter-gram-second system of electro-magnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grams in mass, of a constant cross-sectional area, and of the length of 106.3 cm.

(2) The unit of current shall be what is known as the international ampere, which is one-tenth of the unit of current of the centimeter-gram-second system of electro-magnetic units, and is the practical equivalent of the unvarying current, which, when passed through a solution of nitrate of silver in water in accordance with standard specifications, deposits silver at the rate of 0.001118 gram per second.

(3) The unit of electromotive force shall be what is known as the international volt, which is the electromotive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of an international ampere, and is practically equivalent to $\frac{1000}{1434}$ of the electro-motive force between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of 15° C., and prepared in the manner described in the standard specifications.

(4) The unit of quantity shall be what is known as the international coulomb, which is the quantity of electricity transferred by a current of one international ampere in one second.

(5) The unit of capacity shall be what is known as the international farad, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity.

(6) The unit of work shall be the joule, which is equal to ten million units of work in the centimeter-gram-second system, and which is practically equivalent to the energy expended in one second by an international ampere in an international ohm.

(7) The unit of power shall be the watt, which is equal to ten million units of power in the centimeter-gram-second system, and which is practically equivalent to the work done at the rate of one joule per second.

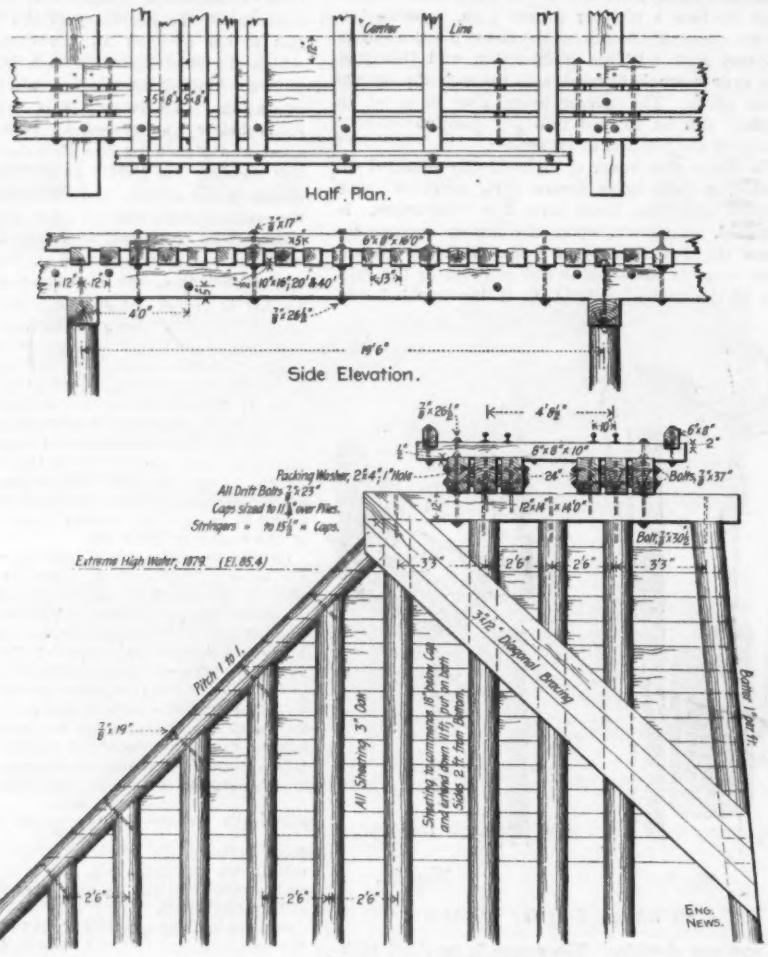
(8) The unit of induction shall be the henry, which is the induction in a circuit when the electro-motive force induced in this circuit is one international volt while the inducing current varies at the rate of one ampere per second.

Sec. 2. That it shall be the duty of the National Academy of Sciences to prescribe and publish, as soon as possible after the passage of this Act, such specifications of details as shall be necessary for the practical application of the definitions of the ampere and volt hereinbefore given, and such specifications shall be the standard specifications herein mentioned.

STANDARD PILE TRESTLE: ELKHART & WESTERN R. R.

We illustrate in the accompanying cut the standard pile trestle designed for the Elkhart & Western R. R. by Mr. A. F. Nims, Chief Engineer, and used for all the pile trestles on that line. The construction is so clearly shown by the drawings as to make much description unnecessary. These drawings show the standard form used on

tangents. For trestles on curves the bents are placed parallel with the line of the stream, and the caps laid on an incline to get the necessary elevation for the outer rail. In all other respects the construction on curves is the same as for the structure illustrated. The point of chief note in the design is the floor system, which is fairly good in the spacing and fastening of the ties and



STANDARD PILE AND TRESTLE BRIDGE, ELKHART & WESTERN R. R.
A. F. Nims, Chief Engineer.

in the double system of guard rails, although a 4-in. spacing and a boat spike driven through every tie in addition to the gaining into the guard rail and stringer would have repaid the extra cost at the first derailment. The beveling of the inner top side of the wooden guard seems to have little to commend it, for it makes it more easily mounted by a derailed truck.

BOOK REVIEWS.

A TREATISE ON HYDRAULICS.—By Mansfield Merriman, Professor of Civil Engineering in Lehigh University. Fifth Edition, revised and enlarged. John Wiley & Sons, New York. 8vo; 427 pp.; illustrated; $4.00.

The value of this work of Prof. Merriman is well proved by the demand that makes a fifth edition necessary. The book is what its title signifies, a treatise on the whole science of hydraulics, brought up to date in its application, and supplemented by many useful tables. Much new matter has been added to this edition, nearly 50 pages in all, treating of flow over weirs and through nozzles, jets, hose and channels. The Niagara turbine plant is fully described and illustrated. The work has been already reviewed in these columns, and it can only be added that the present edition has been carefully revised and several chapters on hydraulic motors have been rewritten and extended.

THE ELEMENTARY PRINCIPLES OF MECHANICS. Vol. II. Statics. By A. Jay Du Bois, C. E., Ph. D., Professor of Civil Engineering in the Sheffield Scientific School of Yale University; Author of "Elements of Graphical Statics;" "The Strains in Framed Structures," etc. First Edition. John Wiley & Sons, New York. 8vo; 392 pp. and diagrams; $4.00.

In this work Prof. Du Bois, with his usual thoroughness, discusses this branch of mechanics, beginning with the inert particle and going on step by step till the study of internal stresses in bodies is reached. As this volume is primarily a text-book for students, arranged both for an abridged and an advanced course, the governing laws are first made plain, and their application is then pointed out. Then follow various examples, such as would occur in ordinary practice, with their solution. The latter portion of the work is devoted solely to the applications of statics, in its relation to retaining walls, dams and slopes; strength and elasticity of materials; theory of flexure, and the continuous girder.

ENGINEERING EDUCATION.—Proceedings of the Second Annual Meeting of the Society for the Promotion of Engineering Education, held in Brooklyn, Aug. 20-22, 1894, in conjunction with the American Association for the Advancement of Science. Vol. II. Edited by Geo. F. Swain, Ira O. Baker and J. B. Johnson. 8vo, 292 pp. Address J. B. Johnson, Secretary of the Society, Washington University, St. Louis, Mo. $2.50.

The Society for the Promotion of Engineering Education was an outcome of the Engineering Congress held in Chicago in 1893, and the number of useful and instructive papers already published by its members are an evidence of the valuable work which may be looked for from this society. The present volume covers the transactions of the meeting held at Brooklyn in August last, and contains about 20 papers, with the discussions upon them. These papers treat of nearly all phases of engineering education, and coming as they do in nearly all cases from teachers in engineering schools, they are interesting as pointing out advances in methods, and also in making plain some of the errors still adhered to in teaching engineering. One very encouraging feature noticed in a number of these papers is the evident general tendency toward the abandonment of the old-time methods of teaching, and the substitution of methods which aim at once to develop and broaden the pupil's abilities, and to give him the practical knowledge that will be of most value to him in his professional life. Evidence of this tendency is furnished by papers on such subjects as the teaching of specifications and the law of contracts; the importance of freehand as well as mechanical drawing to the engineer in cultivating the faculty of quick and accurate perception; the importance of radical change in present methods of field practice and shopwork for students; the value of well-equipped laboratories and workshops, etc.

In the days when the teaching of mathematics was supposed to be the chief function of the school in educating the engineer, there was a broad gulf between the professional engineer and the teacher of "engineering," and with reason, as the teacher was in not a few instances a superannuated clergyman. But since those long ago days the distance between theory and practice, between the school and the shop and office, has been rapidly lessening. At the present day the best schools of engineering and the best teachers in these schools are those who are in closest touch with the conditions and needs of every-day work in the profession.

An admirable evidence of the changed relations of the schools and the teachers to the profession is furnished by the character of some of the professional treatises written by these teachers, and universally conceded to stand in the front rank of engineering works. The old text-books were too often a hodge podge of empirical rules, not infrequently so involved that very few students could intelligently use them, and there was always a doubt whether the author himself fully understood them in all their bearings.

The character of the text-books of to-day, however, is too familiar to need explanation here. There can be no wide gulf between the schools and the shops when the same work is used as a text-book by the student and as a trusted and valued work of reference by the engineer in active practice.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Location of Boundaries.

Where, in a description of land, the line of a survey is stated to be one of the boundaries, but the distance given in the course towards the survey will not carry the land to the line, the survey line will control.—Worsham v. Chisum (Ct. of Civ. App. of Tex.), 28 S. W. Rep., 905.

Liability for Negligence in Payment for Public Improvements.

A stipulation in a contract, by a city for a public improvement, that the contractor shall look for payment to a particular fund, to be raised by assessment, does not relieve the city from liability for negligently delaying to raise such fund. The law imposes an obligation upon the municipal corporation, when it orders an improvement of the streets, to put the necessary machinery in motion, and to prosecute in good faith, and with reasonable diligence, the means afforded to it, under its charter, to raise and collect the funds by an assessment of the property affected by the improvement, in order to redeem its obligation. And a failure on the part of the city to comply with any requirement of the charter, by which the funds may be realized, would subject it to a general liability.—Little v. City of Portland (Supr. Ct. of Ore.), 37 Pac. Rep., 911.

Liability of Contractor for Obstructing Street.

A contractor engaged in constructing a sewer, who, with the consent of the city officers, places an obstruction on the sidewalk, but fails to guard it so as to protect the public from injury, whereby a person is injured, is liable to the city for such damages as it has been compelled to pay on account of an injury. Consent by a municipal corporation to a person to do a lawful act, merely permits it to be done in a careful, prudent and lawful manner; and when it is performed in any other manner, and injury to a third person ensues, the author of the injury is liable therefor.—Mayor, etc., City New York v. Brady, 31 N. Y. S. Rep., 1122.

Liability of a City to a Contractor.

A city contracted with a party to do certain work upon its streets, for which he was to accept its bonds in payment. During the progress of the work it was discovered that it had no authority to issue such bonds, ordered the work stopped, and declined to pay for what had been done, on the ground that the contractor had bound himself to depend upon this source of payment alone. The United States Circuit Court of Appeals, third circuit, decided that the contract contemplated and required valid bonds, and that the city having failed to furnish such, the contract was broken, and it was liable to pay the same from its treasury. It had received the benefit of the contract, and it matters not that the promise was to pay in a manner unauthorized by law. It would be sanctioning rank injustice to hold that payment need not be made at all, on the ground that the issuing of the bonds would be illegal.—Barber Asphalt Paving Co. v. Harrisburg, 64 Fed. Rep., 286.

When Contracts Let Without Bidding are Void.

Where the laws provide that contracts for municipal improvements shall be let to the lowest responsible bidder, a provision in a contract which fixes the prices for extra work without having invited bids on that subject is illegal, and payments at rates specified may be enjoined at the suit of a taxpayer.—Moynahan v. Birkett (Sup. Ct., 2d Dept.), 31 N. Y. S. Rep., 293.

Liability of City for Negligence of Officers.

The city of Milwaukee is not liable for injuries to property of an owner of a private sewer, caused by the negligence of the board of public works in reconnecting such private sewer with the main sewer after lowering the latter, as it was not an act within the line of the corporate duty of the board.—Streiff v. Milwaukee (Supr. Ct. Wis.), 61 N. W. Rep. 770.

CONTENTS OF SUPPLEMENT.

PERSONALS..... 137
ENGINEERING SOCIETIES..... 137
Coming Technical Meetings..... 137
NEW PUBLICATIONS..... 137
Trade Publications..... 138
CONSTRUCTION NEWS:
List of Contracts Pending..... 138
Railways..... 138
Street and Electric Railways..... 139
Electric Light and Power..... 139
Bridges..... 140
Buildings..... 140
Water-Works..... 140
Irrigation..... 141
Sewerage..... 141
Garbage Disposal..... 141
Streets and Roads..... 141
Contract Prices..... 141
Miscellaneous Contracts and Supplies..... 144
INDUSTRIAL NOTES..... 144

PERSONALS.

Mr. Charles H. Cornes has been elected City Engineer at Lockport, N. Y.

Mr. Edward A. Bowers, Superintendent of Water-Works, Lyons, N. Y., died suddenly April 27.

Mr. Jesse Waters has been appointed Superintendent of the Midland Terminal Ry., with o ces at Gillett, Colo.

Mr. Edward S. Atwood has been appointed Superintendent of Docks in the Department of Docks, New York city.

Mr. M. E. Rawson has been appointed City Engineer of Cleveland, O. He was formerly Assistant Engineer in the Department of Public Works.

Mr. Paul S. King, M. Am. Soc. C. E., has resigned his position as General Manager of the Whitaker Cement Co., and will sail for Europe on May 4 for a trip of two or three months.

Mr. William Sheldon Humphrey, Assoc. M. Am. Soc. C. E., Bridge Engineer of the Missouri, Kansas & Texas R. R., died at his home at Parsons, Kan., April 18.

Mr. C. V. Sheldon, of the firm of Dousman & Sheldon, civil engineers, Milwaukee, Wis., has been appointed a special agent of the Land Department to examine government surveys.

Mr. W. H. Jaques, M. Am. Soc. C. E., of New York, N. Y., delivered a lecture on "Guns and Explosives" before the students of the Rensselaer Polytechnic Institute, Troy, N. Y., on April 29.

Mr. George Waite has been appointed Village Engineer of La Grange, Ill. He has had extensive experience in railway engineering, and was for several years engineer for the South Park commissioners.

Mr. C. G. Force, M. Am. Soc. C. E., has been appointed Chief Assistant Engineer in the Department of Public Works at Cleveland, O., and will be in charge of the bridge and sewer work particularly. He was City Engineer for six years.

Mr. John S. Ogden, Chief Engineer of the Bureau of Water, Philadelphia, Pa., has resigned. He has been connected with the Water Department for about 30 years, and was elected by the Councils as Chief of the Bureau in 1886, succeeding Col. Ludlow.

Mr. J. J. R. Croes, M. Am. Soc. C. E., has been appointed one of the Commissioners of the State of New York to confer with similar representatives of the state of New Jersey for the acquisition of the Palisades of the Hudson River by the United States government.

Mr. Martin, the Chief Engineer of the French steamship "La Gascogne," has been awarded the cross of the Legion of Honor by the French government for his skill in bringing the steamer safely into port with disabled engines. The accident was noted in our issue of Feb. 14.

M. John W. Carrington, civil engineer, died in Brooklyn, N. Y., April 22. He was born at Danbury, Conn., in 1817, graduated from the University of the City of New York in 1836, and was engaged on railway work in Cuba and Nicaragua. He retired from practice some years ago.

Mr. Stanciffe B. Downes, Jun. Am. Soc. C. E., died in New York April 21. He was born in this city in 1859, graduated from the Columbia College School of Mines in 1882. He was connected with the Department of Parks in the preparation of maps of the annexed district, and was also engaged on the engineering work of the improvement of that district.

Mr. C. C. Wrenshall, formerly Engineer of Maintenance of Way of the Northern Pacific R. R., and later Chief Engineer of the Anniston & Montgomery R. R., has been appointed Superintendent of the Ewing boatyard, under the Division Engineer of the Missouri River Commission, at Osage City, Mo., and will have charge of all construction and repairs of machinery, boats and other plant.

Mr. William J. Richardson, Secretary of the American Street Railway Association since 1882, and for many years connected with the Atlantic Ave. R. R., of Brooklyn, N. Y., died in New York, April 26. He was born in Albany, N. Y., in 1849, and assisted his father in the management of several street railways, his father eventually becoming president of the Atlantic Ave. R. R. Co.

Mr. George H. Frost, of this journal, and Mrs. Frost, arrived in New York April 27 on the steamer "New York," after a trip of about three months in Europe. During his stay in England Mr. Frost took the opportunity of examining the sewage disposal farms at Wimbledon and Croydon, two of the best examples of this class of work, with a view to the construction of a sewage disposal system for Plainfield, N. J., Mr. Frost being chairman of the committee on sewers of that city.

Mr. Franklin Fairbanks, President of the well-known scale manufacturing firm of E. T. Fairbanks & Co., died at St. Johnsbury, Vt., April 24. He was born in that city in 1828, and entered the employ of the firm at the age of 17. He was associated with his brother in the construction of the Vermont Division of the old Portland & Ogdensburg R. R., and was interested in many railway and mining enterprises, being a director of the St. Johnsbury & Lake Champlain R. R., the Boston & Montana Copper Mines Co., and the Maritime Canal Co., of Nicaragua.

Gen. John Newton, ex-Chief of Engineers, U. S. Engineer Corps, died in New York, May 1, after a short illness. He was born in Norfolk, Va., in 1823, and graduated at West Point in 1842. He was engaged in the construction of fortifications and other engineering work on the Atlantic coast, and served with the volunteer service and in the engineer corps during the war, being breveted lieutenant-colonel of engineers at the close of the war. Later he was in charge of the removal of the obstructions at Hell Gate in New York Harbor, and became Chief of Engineers, with title of Brigadier General in 1884. In 1886 he was appointed by Mayor Grace as Commissioner of Public Works of New York city, but resigned during Mayor Hewitt's term of office. Since April, 1888, he has been president of the Panama R. R.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
May 4. Secy., L. F. Rondinella, 1122 Girard St.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
May 6. Secy., C. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
May 6. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N.Y.
COLUMBIAN ENGINEERING SOCIETY.
May 7. Secy., W. F. Hart, University Building, 15th and H. Sts. N. W., Washington, D. C.
NEW ENGLAND RAILROAD CLUB.
May 8. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 8. "Compound Locomotives," by F. W. Dean. Secy., F. R. Hutton, 12 W. 31st St., N. Y. city.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
May 9. Secy., James K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
May 9. Secy., H. D. Ruhm, Nashville, Tenn.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
May 9. Secy., C. H. McLeod, 12 Mansfield, St., Montreal.
MONTANA SOCIETY OF CIVIL ENGINEERS.
May 11. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
INDIANAPOLIS ENGINEERING CLUB.
May 11. Secy., C. C. Brown, City Engineer.
ENGINEERS' CLUB OF KANSAS CITY.
May 13. Secy., F. W. Tuttle, Baird Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
May 14. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
May 14. Secy., F. A. Coburn, Case Library Building.
NORTHWEST RAILWAY CLUB.
May 14. Secy., C. A. Seley, Metropolitan Block, St. Paul, Minn.
WISCONSIN POLYTECHNIC SOCIETY.
May 14. Secy., W. K. Means, Loan & Trust Building, Milwaukee.
DENVER SOCIETY OF CIVIL ENGINEERS.
May 14. Secy., H. Breen, 36 Jacobson Block.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
May 15. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
May 15. Secy., F. Van Vleck, Los Angeles, Cal.
WESTERN SOCIETY OF ENGINEERS.
May 15. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
BOSTON SOCIETY OF CIVIL ENGINEERS.
May 15. Secy. S. E. Tinkham, City Hall, Rooms 36 Bromfield St.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
May 15. "Water-Works of Syracuse, N.Y.," by W. R. Hill. Annual meeting at Nantasket, Mass., June 18. Secy., C. W. Hunt, 127 E. 23d St., N. Y. city.
ENGINEERS' CLUB OF ST. LOUIS.
May 15. "An Experimental Investigation of the Three-Movement Theorem," by M. A. Howe. Secy., W. H. Bryan, Turner Block.
NEW YORK RAILROAD CLUB.
May 16. Secy., John A. Hill, 256 Broadway, N. Y. city.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
May 16. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
May 16. Secy., J. F. Wilson, Odd Fellows' Temple.
ENGINEERS' CLUB OF MINNEAPOLIS.
May 20. Secy., E. Nexson, Kasota Block.
WESTERN RAILWAY CLUB.
May 21. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
ENGINEERING CLUB OF COLUMBUS, O.
June 1. Secy., David Buell.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
June 7. Secy., O. H. Von Gelden, 819 Market St., San Francisco.
MASTER CAR BUILDERS' ASSOCIATION.
June 11. Annual Convention at Alexandria Bay, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago, Ill.
ASSOCIATION OF RAILWAY TELEGRAPH SUPTS.
June 12. Montreal, Que. Secy., P. W. Drew, Wisconsin Central Ry., Milwaukee, Wis.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 14. Secy., D. W. Meeker, St. Paul, Minn.
AMERICAN RAILWAY MASTER MECHANICS' ASSOC'N.
June 17. Annual Convention at Alexandria Bay, N. Y. Secy., Angus Sinclair, 256 Broadway, New York city.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on April 20 Mr. J. Chester Wilson read a paper upon "Electrical Heating," both for industrial and domestic purposes. He said that while the commercial efficiency of a coal range, for cooking, ranges from 3 to 6%, the heat efficiency of the average central electric station is about 6%, and this can be improved. For heating passenger cars, on electric railways, the electric heater costs from 12 to 18 cts. per day, as compared with 20 to 35 cts. for the car stove.

L. F. Rondinella, Secy.

INDIANAPOLIS ENGINEERING CLUB.—At the meeting April 27 Prof. M. A. Howe, of the Rose Polytechnic Institute, gave an explanation of a method developed for obtaining diagrams showing the movements of a bridge joint under moving load, and showed a number of the diagrams obtained with the machine. Three motions were observed. The first is longitudinal, and always in the direction of the roller end; this does not seem to be important, and will probably be neglected in future experiments. The second is transverse, and does not follow any fixed law; it sometimes shows the effects of cumulative vibration, and is shown most constantly by the engine and the last car of a train, but also appears at intervals during the passage of a train; the earlier results showed some residual motion after the train was off the bridge, but later results with the improved apparatus showed cessation of vibration on removal of load from bridge. The third and most important motion is the vertical motion, which shows the effect of each truck on the deflection of the bridge. The diagrams giving loads on each car or engine and the line of deflection showed the intimate relation. The results seldom show cumulative vibrations, even when the length of cars in proportion to length of panels corresponds to the length said by Prof. Robinson to produce such cumulative vibrations. It also appears evident from the diagrams that the effect of impact on the main trusses is extremely small, if anything, for the bridges tested, and that therefore the usual addition of material for such effects is apparently unnecessary. Two bridges have been tested in detail. One of 120 ft. span was tested at a joint on the lower chord at the center of the bridge, and one of about 100 ft. span was tested at the joint nearest the center. The results on the two bridges compared well. Experiments were also made with a 33-ton switch engine to show the effect of various speeds, directions of motion of load, application of brake, etc. The development of the apparatus used resulted in the use of a pointer attached to the bridge, which actuates three pen points, producing records on a cylinder, which also has connections to show the seconds, and the time of passage of each wheel of the train at each end of the bridge and at the center.

Chas. C. Brown, Secy.

NEW PUBLICATIONS.

THE FRANKLIN INSTITUTE of the State of Pennsylvania for the promotion of the mechanic arts. A sketch of its organization and history. Compiled by William H. Wahl, Secretary of the Institute. Published by the Institute, Philadelphia. 8vo; 103 pp.

This is an interesting history of this institution, founded in 1824, mainly through the personal efforts of Mr. Samuel V. Merrick and Prof. William H. Keating. It contains a full history and list of officers and benefactors, and sets out at length its purpose and the influence it has wielded in the last three-quarters of a century in and about Philadelphia.

READY HELP FOR LOCOMOTIVE ENGINEERS. By Norman Gardenier. Philadelphia, Edward Meeks. Cloth; 16mo; pp. 117; $1.

This is a book of the question and answer type, intended for the use of firemen seeking promotion, for examiners in selecting men for promotion or employment, and for enginemen on the road. There are 506 questions, of which 427 refer to the theory, construction and handling of the locomotive, and the breakdowns to which it is liable, and the rest refer to the air-brakes. These are all arranged in the first part of

the book, and are followed by the answers, correspondingly numbered. Much useful practical information has been condensed into the small space of a book which may be carried in the pocket. The book is strongly bound and well printed.

TRADE PUBLICATIONS.

FILES.—Nicholson File Co., Providence R. I. Oblong, 6 × 4½ ins.; pp. 60.

This is a miniature copy of the large catalogue of files and special tools noted in our issue of Feb. 7.

HOD ELEVATOR.—Gust. Pers. Wern, Havemeyer Building, New York city. 8vo; pp. 10; illustrated.

This pamphlet shows a non-friction elevating machine for brick or mortar hods. It is operated by hand, power being transmitted from the shaft to the drum by a link belt and sprocket wheel.

DREDGES.—Missouri Dredge Co., Kansas City, Mo. Oblong, 9¼ × 5¾ ins.; pp. 24.

The dredges shown are of the ladder type, with the ladder wider at the lower than at the upper end, thus giving the buckets a larger breast to work against. Sand and placer mining dredges are shown, together with engines, boilers, pumps, etc.

DRYING MACHINES.—F. D. Cummer & Son Co., Cleveland, O. Oblong, 9 × 6 ins.; pp. 76.

This is an illustrated catalogue of drying and calcining machines for various purposes and materials, ore washers and roasters, hot-air apparatus and dry kilns, scouring and cooling apparatus and other appliances; also drying tunnels for cement, bricks, lumber, etc.

TESTING MACHINES.—Riehle Brothers' Testing Machine Co., Philadelphia, Pa. Paper; 9½ × 12 ins.; pp. 122; illustrated.

This is a re-issue of the former catalogue, with supplemental pages giving descriptions of the machines and instructions for operating them, notes on testing, strain diagrams, etc., and showing also an automatic and autographic testing machine of 200,000 lbs. capacity, and the Riehle-Anderson track jack. Besides these there are the well-known machines and appliances made by this company.

WATER-TUBE BOILERS.—Hogan Boiler Co., Middletown, N. Y. 21 plates, 7 × 10 ins.

This is a set of engravings of views and details of the Hogan boiler, which has vertical tubes extending from one or two lower drums to a large upper drum. This boiler, or rather its inventor, attracted considerable attention some time ago by propounding the novel idea that the formation of steam in the tubes of a water-tube boiler was detrimental to good circulation. The company has continued operations, however, and now announces that it has its boilers ready for the market.

GARBAGE CREMATION: Chas. Thackeray & Co.'s Patent Incinerator and Cremation Systems for the Disposal of Town Refuse, Night Soil and Dead Animals. 145 St. James St., Montreal; 253 Broadway, New York city. 8vo; paper; pp. 19; two half-tone views.

One-fourth the space in this pamphlet is taken up with a reprint, although no credit is given, of the description of the garbage incinerator built by this company at Montreal and described in our issue of Nov. 29, 1894. The company is prepared to build furnaces for the destruction of night soil, and aims to utilize heat from its garbage incinerator.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
May	3 Life saving station at Gay Head, Mass.		Apr. 18
	Advertised, Eng. News, Apr. 18 and 25.		
May	3. Cement, etc.,	Washington, D. C.	Apr. 25
May	3. School building,	Providence, R. I.	Apr. 25
May	3. Telegraph supplies,	Brooklyn, N. Y.	Apr. 25
May	3. Grading, etc.,	Washington, D. C.	Apr. 25
	Advertised, Eng. News, Apr. 25.		
May	3. Brick sewers,	Richmond, Ind.	Apr. 11
May	3. Pipe sewers,	Richmond, Ind.	Apr. 11
May	4. Roads (7½ miles),	Vevay, Ind.	Apr. 4
May	4. Cast iron pipe,	Homestead, Pa.	Apr. 25
May	4. Brick, cement, etc.,	Toronto, Ont.	Apr. 25
May	4. Paving,	Des Moines, Ia.	Apr. 25
May	4. Pipe sewers,	Westport, Mo.	Apr. 25
	Advertised, Eng. News, Apr. 25.		
May	4. Electric fire alarm,	Cobourg, Ont.	Apr. 25
May	4. Pipe sewers (4,750 ft.),	Bar Harbor, Me.	May 2
May	4. Grading (1,900 lin. ft.),	N. Providence.	May 2
May	4. Bridge,	Dayton, O.	May 2
May	6. Bridges,	Los Angeles, Cal.	Apr. 11
May	6. Sewers,	Cincinnati, O.	Apr. 11
May	6. Paving,	Cincinnati, O.	Apr. 11
May	6. Bridge,	Meridian, Miss.	Apr. 18
May	6. Brick paving,	Erie, Pa.	Apr. 25
	Advertised, Eng. News, Apr. 25 and May 2.		
May	6. Flagging,	Brooklyn, N. Y.	Apr. 25
May	6. Main sewer,	Brooklyn, N. Y.	Apr. 25
	Advertised, Eng. News, May 2.		
May	6. Asphaltum block paving,	Erie, Pa.	Apr. 25
	Advertised, Eng. News, Apr. 25 and May 2.		
May	6. Asphalt block paving,	Poughkeepsie.	Apr. 25
May	6. Dredging, etc.,	Lorain, O.	Apr. 25
	Advertised, Eng. News, Apr. 25 and May 2.		
May	6. Cast iron pipe,	Syracuse, N. Y.	Apr. 25
	Advertised, Eng. News, Apr. 25.		
May	6. Sheet asphalt paving,	Erie, Pa.	Apr. 25
	Advertised, Eng. News, Apr. 25 and May 2.		
May	6. Paving brick,	Boston, Mass.	May 2
May	6. Granite paving,	Taunton, Mass.	May 2
May	6. Granite block paving,	Albany, N. Y.	May 2
May	6. Brick sewer,	Albany, N. Y.	May 2
May	6. Fire-engine houses (3),	Brooklyn, N. Y.	May 2
May	6. Sewers, etc.,	Rochester, N. Y.	May 2
May	6. Electric light plant,	Bay View, Md.	May 2
May	6. Brick sewer (1,350 ft.),	Des Moines, Ia.	May 2
May	6. Dredging,	Toronto, Ont.	May 2
May	7. Paving,	Terre Haute, Ind.	Apr. 11
May	7. Bridge,	Houghton, Mich.	Apr. 18
May	7. Water-works system,	Scranton, Miss.	Apr. 25
May	7. Pipe sewers,	Buffalo, N. Y.	Apr. 25
May	7. Iron Bridge,	Buffalo, N. Y.	Apr. 25
May	7. Granite block paving,	Providence, R. I.	May 2
May	7. Trinidad asphalt paving,	Providence.	May 2
May	7. Pipe sewers,	Buffalo, N. Y.	May 2
May	7. Stone at Horseshoe Reef light station.		May 2
May	7. Water-works supplies,	Reading, Pa.	May 2
May	7. Grading, etc.,	Ludington, Mich.	May 2
May	7. Bridge work,	Ludington, Mich.	May 2
May	7. Asphalt paving,	Indianapolis, Ind.	May 2
May	7. Pipe sewers,	Indianapolis, Ind.	May 2
May	8. Well, near	San Antonio, Tex.	Apr. 25
May	8. Macadamizing,	Alfred, N. Y.	Apr. 25
	Advertised, Eng. News, Apr. 25 and May 2.		
May	8. Paving,	Hoboken, N. J.	Apr. 25
May	8. Sewers,	Brooklyn, N. Y.	May 2
May	8. Rebuilding pumping engines,	Buffalo.	May 2
May	9. Courthouse,	Decatur, Tex.	Apr. 18
May	9. Pipe sewers,	Williamsport, Pa.	Apr. 25
	Advertised, Eng. News., Apr. 25.		
May	9. Stand-pipe,	Schenectady, N. Y.	Apr. 25
	Advertised, Eng. News., Apr. 25.		
May	9. Granite block paving,	New York, N. Y.	May 2
May	9. Bonds ($60,000),	Logan, O.	May 2
May	10. Bridge,	Plymouth, Ind.	Apr. 11
May	10. Paving,	St. Louis, Mo.	Apr. 25
May	10. Drill hall,	Newport, Ky.	Apr. 25
May	10. Cast iron pipe,	West Point, N. Y.	May 2
May	10. Brick paving,	Cincinnati, O.	May 2
May	10. Wharf at Gardner's Creek,	N. B.	May 2
May	10. Pipe sewers,	Pittsburg, Pa.	May 2
May	11. Stone,	Pittsburg, Pa.	Apr. 18
	Advertised, Eng. News, Apr. 18 to May 2.		
May	11. Schoolhouse,	Cleveland, O.	Apr. 18
May	11. Pumping station,	Dighton, Kan.	Apr. 25
May	11. School building,	Cleveland, O.	Apr. 25
May	11. Bridges,	Leavenworth, Kan.	Apr. 25
May	11. Iron fence,	Napoleonville, La.	Apr. 25
May	11. Water tunnel work,	Buffalo, N. Y.	May 2
May	11. Sewers,	Cincinnati, O.	May 2
May	11. Stone paving,	Cleveland, O.	May 2
May	11. Bridge superstructure,	Youngstown, O.	May 2
May	13. Plans for court house,	Liberty, Tex.	Apr. 11
May	13. Sewers,	Yonkers, N. Y.	Apr. 18
May	13. Brick paving,	Carbondale, Pa.	Apr. 25
	Advertised, Eng. News, Apr. 25 to May 9.		
May	13. Laying water pipe,	New Orleans, La.	May 2
	Advertised, Eng. News, May 2 and 9.		
May	13. Valve boxes (600),	Syracuse, N. Y.	May 2
May	13. Water-works system,	Decatur, Ind.	May 2
	Advertised, Eng. News, May 2 and 9.		
May	13. Sewer materials,	Baltimore, Md.	May 2
May	14. Levee (600,000 cu. yds.),	Rock Island, Ill.	Apr. 18
	Advertised, Eng. News, Apr. 18 to May 9.		
May	14. Coal,	Wilmington, N. C.	Apr. 18
	Advertised, Eng. News, Apr. 18 to May 9.		
May	14. Construction work,	B'klyn navy yard.	May 2
May	14. Paving,	Buffalo, N. Y.	May 2
May	14. Boiler and engine,	Tompkinsville, N. Y.	May 2
	Advertised, Eng. News, May 2 and 9.		
May	14. Brick boundary wall,	B'klyn navy yard.	May 2
May	15. Smokeless powder,	Washington, D. C.	Apr. 4
May	15. Bridge,	Glendive, Mont.	Apr. 4
May	15. Memorial hall,	West Point, N. Y.	Apr. 11
	Advertised, Eng. News, Apr. 11 to May 2.		
May	15. Plans, etc., for bridge,	Montreal	Jan. 24
	Advertised, Eng. News, Jan. 24 and 31.		
May	15. Barracks, etc., at	Fort Myer, Va.	Apr. 18
May	15. Bonds ($215,000),	Schenectady, N. Y.	Apr. 18
May	15. Telephone franchise,	Jackson, Tenn.	Apr. 25
May	15. Plans for club house,	New Orleans, La.	May 2
May	15. Brick paving,	Haughville, Ind.	May 2
May	15. Distillery,	Terre Haute, Ind.	May 2
May	15. Electric light plant,	Orting, Wash.	May 2
May	16. Dredging,	Philadelphia, Pa.	Apr. 25
May	16. School building,	Toledo, O.	Apr. 25
May	17. Pipe, etc., and pipelaying,	St. Louis.	May 2
May	17. Building,	Pittsburg, Pa.	May 2
May	18. Stone buildings, at	Santa Fe, N. Mex.	Apr. 25
May	18. Lock,	St. Louis, Mo.	Apr. 25
	Advertised, Eng. News, Apr. 18 to May 9.		
May	18. Remodeling school building,	Cleveland, O.	Apr. 25
May	18. Reconstructing water-wks.,	Brazil, Ind.	May 2
May	18. Dike at	Everett, Wash.	May 2
May	19. Pipe sewers (14,500 ft.),	Waco, Tex.	May 2
May	20. Water bonds,	Santa Clara, Cal.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 28.		
May	20. Court-house,	Wrightsville, Ga.	Apr. 4
May	20. Street improvements,	Fostoria, O.	May 2
May	21. Dredging,	Montgomery, Ala.	Apr. 18
	Advertised, Eng. News, Apr. 18 to May 9.		
May	21. Pumping engines, etc.,	Brooklyn, N. Y.	Apr. 11
	Advertised, Eng. News, Apr. 11 and 25.		
May	21. Addition to U. S. bldg.,	Washington.	May 2
May	21. Water-wks system,	Mount Pulaski, Ill.	May 2
	Advertised, Eng. News, May 2.		
May	21. Paving bonds ($4,800),	Salem, O.	May 2
May	21. Brick paving (3,076 sq. yds.),	Salem, O.	May 2
May	21. Brick paving,	Frankfort, Ind.	May 2
	Advertised, Eng. News, May 2 and 9.		
May	22. Drill hall,	Halifax, N. S.	May 2
May	23. Water-wks. system,	Santa Clara, Cal.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 28.		
May	23. Public building, at	New London, Ct.	May 2
May	23. New water supply,	Schenectady, N. Y.	May 2
	Advertised, Eng. News, May 2.		
May	23. Bridge,	Winnipeg, Man.	Apr. 18
May	24. Excavating at	Newburg, N. Y.	May 2
May	27. Dams & shore protections,	Miss. River.	May 2
	Advertised, Eng. News, May 2 to 23.		
May	28. Jail,	Brazil, Ind.	Apr. 25
May	29. Machine tools,	Watertown, Mass.	May 2
Jun.	1. Electric lighting,	Vancouver, B. C.	Apr. 25
Jun	1. Water-works system,	Postville, Ia.	May 2
Jun.	3. Courthouse plans,	Winfield, W. Va.	Apr. 18
Jun.	7. Bridge,	Versailles, Ind.	Apr. 18
Jun.	15. Irrigation canal,	Portland, Ore.	Apr. 18
July	3. Bridges,	Ukiah, Cal.	Apr. 18
Aug.	5. Plans for state capitol,	St. Paul, Minn.	Apr. 25
Oct.	1. Plans for art building,	Philadelphia, Pa.	Apr. 11
No date.	Electric railway materials,	Bristol, Ct.	Apr. 25
"	Artesian well,	Alvarado, Tex.	May 2

RAILWAYS.

East of Chicago.

AKRON & EASTERN.—A press report states that E. P. Reighard, of Pittsburg, Pa., has purchased a controlling interest in this road and that the construction will soon be resumed and the road completed from Akron, O., to New Castle, Pa., 70 miles.

ATLANTIC & LAKE SUPERIOR.—A press report from Montreal states that C. N. Armstrong, Supt., has returned from London where he made arrangements for floating bonds to complete 20 miles of the Baie des Chaleurs road yet unbuilt, and 80 miles of the Great Eastern, which with the Intercolonial will give the company by the end of the year an independent line from Montreal to Paspebiac. It is stated that the new $5,000,000 bridge to be built at Montreal, for which plans will be received until May 15, as advertised in Engineering News of Jan 24 and al, is projected by this company.

BANGOR & AROOSTOOK.—Aroostook county, Me., has voted a subsidy of $4,000 a mile for a branch of this road from Oakfield through Masardies to Ashland, a distance of 42 miles. It is expected that the construction will be commenced at once and completed this year.

BATAVIA & NORTHERN.—A press report from Batavia, N. Y., states that Robert Schemerhorn, Ch. Engr., has completed the survey of this road from Oak Orchard to Batavia. Pres., Robt. Avery, 45 Broadway, New York.

CHICAGO & EASTERN INDIANA.—A press report from Muncie, Ind., states that work on this road has been completed to Wheeling, 10 miles northwest of Muncie, and has been temporarily stopped. A new survey is now being made. The road is projected to Columbus, O., and is being laid with 50-lb. steel rails.

CHICAGO, INDIANAPOLIS & CHATTANOOGA SOUTHERN.—It is reported that grading was begun April 17 on six miles of this road from Rockport, Ind., north to Grandview and the grade is to be completed to the latter place by June 20. Ch. Engr., C. H. Wright, 81 Clark St., Chicago.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—It is reported that at a meeting of the directors last week, it was decided to build from North Veuron, Ind., to Louisville, Ky., 53 miles, at once. It is stated that surveys are now being made and that the line will enter Louisville over the new Ohio River bridge.

COAST RY. OF NOVA SCOTIA.—The construction of this railway along the southern coast of Nova Scotia has been resumed by the Nova Scotia Development Co. The "Railroad Gazette" states that this work has been suspended for some months on account of the conflict with the South Shore Co., which was building over the same route. The charter under which the South Shore Co. claimed to be acting has been declared to have lapsed by the Attorney-General of Nova Scotia, and the project seems to have been finally abandoned. The Coast Railway, which had begun the construction of its line before the other company, now has something like 20 miles of railway graded south and east of Yarmouth, and it is expected to have 30 miles of the road in operation by August. The contracts for the bridges are to be let at once and it is also expected to start the tracklaying shortly. The president of the Nova Scotia Development Co. is John A. Brill, a car builder of Philadelphia, and A. H. Chadbourne is superintendent of construction. The work was resumed early in April and the force of men now working on the line will be increased as the weather permits. The total length of the line is to be 90 miles to Shelburne and Lockport, N. S., and the company has a subsidy from the Provincial Government for this entire distance. Thomas Robertson is president, S. D. Pettit, secretary, and L. H. Peton, chief engineer.

EASTERN CENTRAL.—Ohio papers are giving considerable space to this projected railway, which would parallel the Pittsburg, Fort Wayne & Chicago. It is stated that considerable of the right of way has been secured and that the construction will be commenced this month. Gen. Jacob Riblet is secretary of the company.

GLOVERSVILLE & BROADALBIN.—Incorporated in New York April 25 to build a standard-gage steam railway from Broadalbin to a point near Warrens Crossing on the Fonda, Johnstown & Gloversville road, about six miles; capital stock, $60,000. This project was noted in our issue of March 28. Ch. Engr., J. Wallace Cleveland, Broadalbin, N. Y.

LOUISVILLE, NEW ALBANY & CHICAGO.—The directors of this company are receiving subscriptions for $1,050,000, including $200,000 for laying 75-lb. steel rails on the Indianapolis Division, and $110,000 for widening narrow-gage, constructing bridges and other improvements.

RAQUETTE RIVER.—Incorporated in New York April 25 to build a steam railway from Tupper Lake to Axton, Franklin county, a distance of 10 miles; capital stock, $100,000; directors, Chas. E. Arnold, A. J. Voyer, W. P. Shaw and others, of Albany, N. Y.; Geo. I. Humphrey, of Saratoga; E. R. Robinson, of Bath, and F. S. Worham, of New York, Mr. Arnold is the principal stockholder.

Southern.

AUGUSTA & CHATTANOOGA.—This road is projected from Augusta, Ga., to Chattanooga, Tenn., 225 miles, and was partially graded several years ago. E. H. Richards, of Atlanta, is interested in a company that is reported to have purchased the road with a view to completing it.

CARRABELLE, TALLAHASSEE & GEORGIA.—It is reported that this road will soon be extended to some place in southern Georgia to secure a direct connection with the north. Pres., William Clark, of New York; Ch. Engr., F. P. Damon, of Tallahassee, Fla.

KENTUCKY.—It is reported that engineers working for the Prescot English Land Co., of London, are making a railway survey through Rockcastle, Pulaski and Laurel counties, Ky., where this company owns 16,000 acres of land along the Rockcastle River and has secured an option on as much more. This section is rich in coal and timber. M. C. Johnson, Prosecuting Attorney for Garrard county, is said to have secured an option on 20,000 acres of land in that section at from $1 to $4 an acre.

KNOXVILLE JUNCTION TERMINAL BELT LINE.—Incorporated in Tennessee by Albert E. Boone,

L. D. Dillon, W. H. Gass and others, to construct a railway around the city of Knoxville, with branch lines to Maryville, Sevierville, Dandridge, Strawberry Plains and other places.

TENNESSEE CENTRAL.—This railway was noted in our issue of last week. G. W. Pearsall, Ch. Engr., Harriman, Tenn., writes us that 60 miles of the road between Monterey and Kingston is now under contract and about 600 men, mostly convicts, are at work along the line. Porter & Newton have the contract for grading 53 miles, and A. Tubman 7 miles. Thomas McFarland, of Knoxville, has the contract for building the tunnel through Walden's Ridge. The grade is completed between Monterey and Crossville, 22 miles, and nearly completed between Kingston and the Cincinnati Southern road, 7 miles.

TUSCALOOSA BELT.—Efforts are being made to secure an extension of this road from Tuscaloosa, Ala., to Brookwood, 16 miles. Pres., W. C. Jamison, Tuscaloosa, Ala.

Northwest.

CHICAGO, PADUCAH & MEMPHIS.—F. P. Read, Ch. Engr., St. Elmo, Ill., writes to the "Railway Age" as follows: The subcontracts for the grading and bridging of the Chicago & Carbondale line (which has been located from Johnston City on the C., P. & M. road to Carbondale), a distance of 18 miles, have been let by Johnston Bros. & Faught, general contractors, to the following contractors: Brown Bros., sections 1 to 3, inclusive; F. W. Johnston & Co., sections 4 to 7, inclusive; C. O. Faught, sections 8 to 9, inclusive; Welsh Bros., sections 10 to 11, inclusive; C. S. Stocker, sections 12 to 13, inclusive; S. A. Campbell, sections 14 to 15, inclusive; C. S. Stocker, section 16; Charles Havens, sections 17 to 18, inclusive. The contract for the bridging has been let to M. S. Carter & Co., of St. Louis, Mo. Work will begin at once.

FOX RIVER VALLEY TERMINAL.—Press reports from Appleton, Wis., state that F. W. McIntyre, of Niagara Falls, N. Y., is organizing a company to construct the projected Fox River Valley Terminal Ry., which is projected from Green Bay along the east bank of the Fox River to Neenah, with extensive docks at Green Bay.

GREAT NORTHERN.—John F. Stevens, Ch. Engr., St. Paul, writes us that there is no truth in the reported awarding of contracts for the extension from Sandstone towards Fosston, Minn.

IOWA CENTRAL.—A press report states that active operations will soon be commenced on an extension from Centerville, Ia., either to Milan or Kirksville, Mo., Gen. Man., L. M. Martin, Marshalltown, Ia.

MINNEAPOLIS, ST. PAUL & ASHLAND.—Press reports from Ashland, Wis., state that arrangements have been made for floating the bonds, and that Balch & Peppard, contractors, have agreed to build the 100 miles of road within 90 days. This railway is projected to connect the cities named, and the organization of the company was noted in our issue of Jan. 31.

WINONA, MARSHALLTOWN & SOUTHERN.—The incorporators of this company met at Marshalltown, Ia., recently and elected officers. The road is projected from Osage, Ia., the present terminus of the Winona & Southwestern, through Floyd, Butler, Grundy, Marshall, Jasper, Marion and Lucas or Monroe counties, tapping the great coal fields of southern Iowa. The surveys were made some time ago, and it is hoped to commence the construction at an early date. Ch. Engr., C. G. Gilman; Secy., A. G. Glick; Pres., N. S. Ketcham; Vice-Pres. and Treas., G. F. Kirby, all of Marshalltown, Ia.

Southwest.

MISSOURI PACIFIC.—Jacob Brickensderffer has completed the preliminary survey for an extension of the Jefferson City & Lebanon branch from Bagnell to Lebanon, Mo.

SPRINGFIELD, HARRISON & LITTLE ROCK.—Surveys have been completed by P. H. Dougherty, Ch. Engr., from Springfield, Mo., to the Newton county (Ark.) line, and it is expected that the construction will soon be commenced.

TEXAS MIDLAND.—E. H. R. Green, Pres., is reported as stating that this road will be extended about 100 miles during this summer.

Rocky Mt. and Pacific.

CALIFORNIA, OREGON & IDAHO.—Incorporated in Oregon to build a standard-gage railway with telegraph and telephone line, beginning at tide-water on the coast of Solano county, Cal., and running north and northeast through Solano, Yolo, Colusa, Glen, Tehama, Shasta, Lasseus and Modoc counties, Cal., and Lake, Harney and Malheur counties, in Oregon, and Owyhee, Cassia, Oneida and Bingham counties in Idaho, to a connection with one or more lines in Wyoming; also a branch from Klamath Falls, Ore., connecting with the main line in Modoc county, Cal., and another leaving the main line in Tehama county and terminating at Eureka, Cal.; capital stock, $800,000; incorporators, J. M. Bassett, Oakland, Cal.; L. W. Brown, Eugene, Ore.; Robert Clow, Junction City, Ore.

UNION PACIFIC, DENVER & GULF. The contract for extending this road between Forbes Junction and Walsenburg has been awarded to A. Sheridan, of St. Joseph, Mo., as noted under Contract Prices.

Foreign.

MEXICAN INTERNATIONAL.—A press report from Durango, Mex., states that Maj. James Killebrew, Ch. Engr., and a corps of assistants are making a final survey for the extension of this line from the city of Durango to the city of Mexico. The survey has been completed for a distance of 45 kilometers from Durango, and will be pushed forward until the terminal point is reached. As soon as this survey is completed and approved by C. P. Huntington, Pres., the active construction of the road will begin.

MEXICO CITY, TAMPICO & RIO GRANDE.—W. S. Calhoun, of Chicago, the president; R. H. McCracken, the concessionnaire; J. P. Nelson, the contractor, and Hon. H. Figuero, the general attorney of this company, left San Antonio, Tex., April 24, for an overland trip over the route of the proposed line between Nuevo Laredo and Tampico, via Matamoros. Press reports state that the stockholders have deposited the necessary capital to insure the building of the road, and a large amount of material has already been purchased, and that the active work of construction will begin within 30 days. The Mexican Government looks upon the building of this road as one of the most important industrial enterprises ever undertaken in that country. It will serve as a military picket line for a distance of about 1,000 miles along the Rio Grande border.

STREET AND ELECTRIC RAILWAYS.

WORCESTER, MASS.—The Spencer, Brookfield & Warren Electric Ry. Co. has petitioned for permission to build an electric railway to Warren. M. H. Potter, E. E. Dickerman, F. W. Boulton and A. E. Kingsley are interested.

PROVIDENCE, R. I.—The Interstate Consolidated St. Ry. Co. has been reorganized, and the road will be improved. Pres., Marsden J. Perry, of Providence; Treas. and Secy., Edward R. Price, of North Attleboro.

NEW BRITAIN, CONN.—The Central Ry. & Electric Co. has petitioned for permission to extend its road to Newington. Ch. Engr., C. D. Jones.

CORTLAND, N. Y.—The Cortland & Homer Traction Co. has petitioned for permission to build an electric road around the base of Greenwood Hill.

BROOKLYN, N. Y.—Local papers state that the Kings, Queens & Suffolk Co. has had $40,000, or one-fifth, of the stock paid in for preliminary plans for the construction of the proposed bicycle electric railway. Surveys have been made for the road along the south shore of Long Island. The bicycle road would connect with the Kings County Elevated Ry.

BUFFALO, N. Y.—It is reported that the Buffalo & Gardenville Electric Ry. Co. will soon apply for a charter; capital stock, $40,000. Henry Hill, 122 Pearl St., is interested.

HERKIMER, N. Y.—The Herkimer, Mohawk, Ilion & Frankfort St. R. R. Co. has increased its capital stock from $55,000 to $150,000 for electrical equipment.

NEWBURG, N. Y.—Press reports state that Benjamin Norton, of Brooklyn, who is at the head of the syndicate that built the Newburg and the Orange Lake electric railways, will, with his associates, open an electric road from Orange Lake to Walden in a month. The same men contemplate similar roads from Newburg through New Windsor, Vail's Gate and Moodna to Cornwall; from Newburg through Middlehope north to Marlborough, and perhaps from Walden over to Goshen.

NEW YORK, N. Y.—The Broadway & Seventh Ave., the Metropolitan St. Ry. Co. and the Central Park, North & East River R. R. Co. have filed plans for proposed extensions to their roads.

NEW YORK, N. Y.—The North New York Junction R. R. Co. has petitioned for a franchise for a road on the north side. H. J. Gumbleton is the attorney. ——The 23d St. R. R. R. Co. has petitioned for permission to equip its road from the North River to the East River with the cable system.——The Sixth Ave. St. Ry. Co. has been granted permission to use an underground electric system on its road on Lenox Ave.——The Esmond International Electric Traction Co. was incorporated in New Jersey April 30 to build electric railways; capital stock, $1,000,000, with $1,000 paid in; incorporators, Chas. C. Dodge, of New York; Frederick C. Esmond, of Brooklyn; Henry Seligman, of Hastings, N. Y.

WESTCHESTER, N. Y.—The Westchester & William's Bridge Traction Co. has been incorporated to build an electric railway; capital stock, $60,000; incorporators, G. P. Morgan, A. G. MacDonnell and Chas. F. Tracy, of New York.

PASSAIC, N. J.—The Passaic & Newark Electric Traction Co. has been incorporated with a capital stock of $250,000, with $25,000 paid in; incorporators, Albert S. Jones, of New York; Chas. A. Stelling, James W. Clinton, of Passaic.

DU BOIS, PA.—The Du Bois Passenger Traction Co. is preparing to construct its electric railway. A. C. Bailey is interested.

GREENSBURGH, PA.—Webb & Perkins, of Williamsport, have been awarded the contract for constructing an electric railway from this place to Turtle Creek, a distance of 20 miles, where it will connect with a line to Pittsburg. A three-mile branch to McKeesport will also be built. The road will cost about $350,000. Electrical Engr., R. H. Crosby.

PHILADELPHIA, PA.—The Philadelphia & West Chester Traction Co. has been incorporated to build an electric railway in Delaware county; capital stock, $181,800, with $18,180 paid in; Treas., Jones Mister, 2221 St. James's Place.——The Collindale St. Ry. Co. has been incorporated to build an electric railway between Darby and Collindale; capital stock, $50,000; Pres., Eli B. Hallowell, 3300 Race St.

PITTSBURG, PA.—The Pittsburg, Greensburg & Latrobe Electric Ry. Co. has been incorporated, with a capital stock of $5,000, by Alan D. Woods, John F. Davitt, Richard Fickling and J. Harper Adams. This company is said to be controlled by the Sadler syndicate, which has a capital stock of $1,000,000; Pres., J. L. Mitchell.

PITTSBURG, PA.—The Homestead & Highland Electric Ry. Co. is considering the question of constructing its road down town and ultimately to Duquesne and McKeesport. Pres., R. G. Wood; Gen. Man., S. J. Macfarren.

SECANE, PA.—The Warwick St. Ry. Co. has been incorporated to build a railway from Norwood, through Ridley and Darby townships, to Glenolden and Sharon Hill; capital stock, $50,000; Pres., Issac H. Rhoades.

SOUTH WILLIAMSPORT, PA.—The Edgewood & Sulphur Springs Passenger Ry. Co. has been incorporated to build an electric railway; capital stock, $10,000; Pres., W. E. Ritter.

HARRINGTON, DEL.—The Harrington, Frederica & Denton Ry. Co. has applied for a charter for an electric railway; capital stock, $350,000; incorporators, Robt. W. Reynolds, Ezekiel Fleming, Hezekiah Harrington and B. L. Lewis.

MILFORD, DEL.—The Sussex Electric Ry. Co. has applied for a charter for a road from Milford to Lewes, by way of Milton; capital stock, $350,000; incorporators, John B. Dorman, Wm. B. Tomlinson, Chas. T. Atkins, and E. W. Tunnell.

BEHOBOTH, DEL.—The Henlopen Electric Light & Ry. Co. has applied for a charter; capital stock, $250,000; incorporators, Hiram R. Burton, H. V. Lyons and others.

GRAFTON, W. VA.—The Grafton Traction Co. has been incorporated to build an electric railway between Grafton and Pruntytown; capital stock, $150,000, with $600 paid in; incorporators, F. A. Malan, H. M. Sommerville and E. T. Maltan.

ATLANTA, GA.—Porteous & Wilkins, of New York, have made arrangements with the exposition company to build an intramural railway within the grounds, work on which will soon begin.

COLUMBUS, GA.—The construction of an electric railway between this city and Atlanta, with a branch to Newnan, is proposed. Grigsby E. Thomas, Jr., is interested.

CHATTANOOGA, TENN.—A company has been organized to build an electric railway from Rossville to the Chickamauga and Chattanooga National Military Park. Pres., D. M. Steward.

CANTON, O.—It is reported that the construction of an electric railway between this city and Albion, by way of New Berlin, Uniontown, Greentown and Krumroy, is being considered. W. A. Lynch, Pres. Canton & Massillon St. Ry. Co., is interested.

CLEVELAND, O.—The Cleveland, Painesville & Eastern R. R. Co. has been incorporated to build an electric railway; capital stock, $250,000; incorporators, Henry A. Everett, Julius E. French, J. A. Beidler, Edward W. Moore and Chas. W. Mason.

COLUMBUS, O.—M. J. Degnon, Columbia Bldg., has been awarded the contract for constructing the Columbus Central Electric Ry. in this city and from Columbus to Westerville, a distance of 16 miles. It is reported that it will be about two years before the road is completed, and that it will cost about $800,000.

SPRINGFIELD, O.—It is stated that right of way is being secured for an electric railway between this city and Jamestown, by way of Clifton and Cedarville, a distance of 18 miles. H. L. Canfield, of Xenia, is interested.

TOLEDO, O.—The Toledo Electric St. Ry. Co. has increased its capital stock from $1,400,000 to $1,750,000. Gen. Man., J. J. Robison.

TOLEDO, O.—The Toledo Traction Co. has been incorporated to build a street railway; capital stock, $4,000,000; incorporators, Albion E. Lang, Chas. L. Wight, Winfield S. Jewell, and Edgar H. Eckert.

ANDERSON, IND.—Press reports state that the Clodfelter Gas Belt Electric Road Co., which has had adverse fortune since it was organized several months ago to connect Indianapolis and all of the gas belt cities by an electric railway about 100 miles long, has been reorganized at a special meeting held in Indianapolis. The stockholders are J. D. Lindsay, of New York; W. R. Pierson, of Fairmount; A. W. Painter, V. C. Quick and S. Free, of Alexandria; W. R. Myers and Leon Bailey, of Indianapolis; A. B. Wilgus, Jr., of New York. Pres. and Gen. Man., N. J. Clodfelter, of Crawfordsville; Treas., J. H. Winslow, of Fairmount; Secy., J. T. Sullivan, of Summitville. A contract for the construction work was let to the New York Standard Construction Co., and work is to be begun at three points along the right of way inside of 20 days. The line is to be running between Anderson and Marion by the 1st of September. The capital stock is $500,000. (A. B. Wilgus and the New York Standard Construction Co. receive mail, but have no office, at 77 Nassau St., New York. Mr. Wilgus is a promoter of electric railways, and has secured several contracts and franchises during the last year.—Ed.)

WABASH, IND.—It is reported that James Lynn, of this city, representing capitalists of Worcester, Mass., has applied for a franchise for an electric railway.

ANN ARBOR, MICH.—The Old Mission Resort Association is reported as making arrangements to construct an electric railway from Traverse City to the association grounds this summer. Pres., W. C. Ransom; Secy., Junius E. Beal.

CHICAGO, ILL.—The West Chicago St. Ry. Co. has been granted permission by the West Park commissioners to build its electric road on Twelfth St. and Ogden boulevard.

DANVILLE, ILL.—W. S. Mathias has been granted a 20-year franchise by the county board for an electric railway from Danville to the Iroquois county line, by way of Bismarck, Rossville and Hoopeston, a distance of 30 miles.

PEORIA, ILL.—The City & Prospect Heights St. Ry. Co. has been incorporated with a capital stock of $150,000, by Chas. E. Woodbridge, Wm. S. Turner and John C. White.

DULUTH, MINN.—The Bay View Heights Incline Ry. is to be extended to Proctorknott, according to reports.

INDEPENDENCE, MO.—The Kansas City & Independence Rapid Transit Ry. Co. is considering the question of extending its road. Pres., W. H. Holmes.

ELECTRIC LIGHT AND POWER.

BUFFALO, N. Y.—Alonzo C. Mather has petitioned the legislature for permission to erect a bridge of 200 ft. clear span over the Niagara River, with power wheels to develop the power of the river.

LANSINGBURG, N. Y.—The trustees have voted to advertise for bids for 150 lights for five years.

BAY VIEW, MD.—Bids are asked until May 6 for constructing an electric light plant at the Bay View Asylum. Pres., Simon I. Kemp; John M. McElroy, Purveyor.

ELBERTON, GA.—N. W. Harris & Co., of Chicago, Ill., have purchased $12,000 in bonds voted for an electric light plant. L. L. Stephenson has been awarded the contract for erecting the plant. The power house will be built at once on Beaver Dam Creek, three miles from this city.

KNOXVILLE, TENN.—The board of public works will advertise at once for bids for 200 to 280 arc lights for one to five years.

LAWRENCEBURG, KY.—It is reported that a company will be organized with a capital stock of $40,000, to build an electric light and water-works plant.

STANDISH, MICH.—It is stated that the town has voted $10,000 in bonds for electric lights and water-works.

RANDOLPH, NEB.—R. Boughn has been granted a franchise for an electric light plant.

BILLINGS, MONT.—It is reported that an electric light plant, water-works, etc., estimated to cost $40,000, are to be built at the Crow agency this summer.

STEPHENVILLE, TEX.—The board of trade and the council are considering the question of putting in a combined electric light, water-works and ice plant.

ORTING, WASH.—Bids are asked until May 15 for constructing an electric light plant for the Washington Soldiers' Home. W. McMicken, Secy. Bd. Trustees, Olympia.

FRESNO, CAL.—It is reported that a company has been incorporated to construct an electric plant on the San Joaquin River, 30 miles from this place, to develop and transmit 1,100 HP.

TORONTO, ONT.—An election will be held May 25 to vote on the question of issuing bonds for an electric light plant.

NEW COMPANIES.—The Nunda Electric Light Co., Nunda, Ill.; $5,000; E. G. McCollum, H. H. McCollum.

Hawkeye Electric Co., Sioux City, Ia.; $10,000; L. G. Nilson, H. O. Woodruff, A. W. Craik.

Freeport General Electric Co., Freeport, Ill.; $125,000; Wm. O. Johnson, Newton P. R. Hatch.

Alvarado Water Supply & Light Co., Alvarado, Tex.; $12,000; W. Samson, H. R. Jones, T. B. Pope, I. A. Patton.

Consolidated Electric Light Co., San Francisco, Cal.; $300,000; H. W. Quitzow, G. G. Buckland, James E. Ball, Robt. W. King.

United Motor Co., Cleveland, O.; $10,000; to manufacture electrical instruments; James H. Hoyt, H. H. McKeehan, H. A. Kelley.

Big Four Electric Co., Chicago, Ill.; $200,000; to manufacture electrical apparatus; Wm. H. Brown, Louis H. Gillson, Henry D. Ames.

Kinney Electric Conduit Co., Portland, Me.; $250,000; to manufacture conduit tubes for mining electric wires; Pres., Frank Fuller, Boston; Treas., I. W. Dodge, Beverly.

Kitsee Electric Co., Camden, N. J.; $75,000, with $1,500 paid in; to manufacture dynamos, motors, etc.; John M. Carroll, Camden; Leo J. Tierney, Robt. A. Balfour, Philadelphia.

Vance Electric Co., New York, N. Y.; $10,000; contractors for all classes of electrical construction work; Arthur S. Vance, Brooklyn; John H. Cheever, Elizabeth, N. J.; Chas. C. Guiteau, New York; Chas. A. Allen, Dover, N. J.

Electric Porcelain & Mfg. Co., Trenton, N. J.; $50,000, with $5,000 paid in; to manufacture every kind of porcelain insulating devices for electrical purposes; Carl F. Adam, Ferdinand F. Waechter, David Cross.

BRIDGES.

CHESTER, MASS.—The town has voted to build a one-span bridge, estimated to cost $5,000.

BUFFALO, N. Y.—The board of public works has received the following bids for building an iron bridge, 83 ft. wide, on Niagara St., over Scajaquada Creek: Buffalo Bridge & Iron Works, $7,870; Buffalo Structural Steel Works, $8,400; Edgemoor Bridge Co., Wilmington, Del., $8,728; George W. Moore, $9,100; King Bridge Co., Cleveland, O., $9,300; Wrought Iron Bridge Co., Canton, O., $9,406; Ph. Marburg, $9,622; Detroit Bridge & Iron Works, $10,850.

NEW YORK, N. Y.—A hearing will be given May 15 to consider the matter of the proposed bridge across the South Shrewsbury River at Oceanport, N. J., for the New York & Long Branch R. R. Co. Lieut.-Col. G. L. Gillespie, U. S. Engrs., 39 Whitehall St.

ROCHESTER, N. Y.—The New York Central & Hudson River R. R. Co. has had plans approved for the North St. bridge.

YONKERS, N. Y.—The council has awarded the contract for a bridge across Tuckahoe Brook, at the entrance of Yonkers Park, on Scarsdale Road, near Tuckahoe, to Dougherty & Berrigan, of Yonkers.

NORRISTOWN, PA.—The construction of a bridge over Story Creek at West Norristown, estimated to cost $22,000 to $50,000, has been petitioned for.

KEY WEST, FLA.—A bill has been introduced in the legislature authorizing Monroe county to issue $350,000 in bonds for completing drawbridges and building a road to connect Key West with Key Largo, according to reports.

ST. AUGUSTINE, FLA.—A company has been organized to build a steel bridge across the Matanzas River to connect this city with Anastasia Island, estimated to cost $30,000. H. J. Ritchie, G. H. Brewer, and R. W. Nesbit are interested.

NEW ORLEANS, LA.—The council has adopted a resolution directing the New Orleans Traction Co. to raise and repair the bridge at Esplanade and Broad Sts.—The city engineer has been directed to prepare plans for removing the bridge across the New Orleans Navigation Canal at Carrollton Ave. and erecting it at the West End, and to prepare plans for a new steel bridge over the canal at Carrollton Ave. P. Farrell, Comr. Pub. Wks.; L. W. Brown, Cy. Engr.

KNOXVILLE, TENN.—The New Columbus Bridge Co., Columbus, O., was the lowest bidder for constructing an iron bridge 160 ft. in length over Pigeon River at Pigeon Forge. Morris Cope is the Chattanooga agent.

CLEVELAND, O.—Press reports state that the Cleveland, Lorain & Wheeling R. R. Co. is about to let the contract for 20 steel bridges, to be erected on the line between Urichsville and the Ohio River, to replace the present light bridges and trestles.

DAYTON, O.—Bids are asked by the county commissioners until May 4, according to a press report, for the construction of a bridge over Stillwater River, near the Y. M. C. A. Athletic Park, for which $20,000 in bonds were recently authorized.

KENT, O.—The county commissioners are about to build a new bridge 32 ft. in width at Crane Ave., to take the place of the present iron one.

YOUNGSTOWN, O.—Bids are asked by the county commissioners until May 11 for building the superstructure for the bridge over the Mahoning River at Brier Hill. C. F. Brenner, Audr. Mahoning County.

CONCORD, IND.—It is reported that a county bridge, to cost $4,000 is to be built over the St. Joseph River and two over Bear Creek to cost $1,000 each.

LOGANSPORT, IND.—The county commissioners are considering the question of building a bridge at Market St., over the Eel River.

MUNCIE, IND.—The county commissioners are discussing a petition for a bridge over White River at Washington St.

LUDINGTON, MICH.—Bids are asked until May 7 and 9 for county bridge work, one contract at each date. A. B. Hunter, Chn. Comrs.

SAGINAW, MICH.—The Wrought Iron Bridge Co., of Canton, O., has been awarded the contract for a 440-ft. steel bridge across the Tittabawassee River at $9,994.

FORT SCOTT, KAN.—The commissioners of Bourbon county propose to construct a bridge across the Osage River at Trauber's Ford, estimated to cost $3,000. H. D. Smith, Chn. Bd. Comrs; G. H. Requa, County Clk.

PARSONS, KAN.—It is reported that a new iron bridge is to be built across the Labette River on Gabriel Ave.

HIGHLANDS, COLO.—The town has voted to issue $40,000 in bonds to aid in the construction of the 14th St. viaduct. North Denver voted $95,000 in bonds a short time ago for the same purpose.

BUILDINGS.

BROOKLYN, N. Y.—Bids are asked until May 6 for building three fire engine houses in the 29th ward. T. W. Wurster, Comr. Fire Dept.

BUFFALO, N. Y.—E. A. Beyer has prepared plans for a three-story brick hotel for Mrs. Belle Markens at Huron, Genesee and Washington Sts., to cost $30,000.—The Glenwood M. E. Church Society has obtained permission to build a $28,000 stone and brick church at Utica St. and Linwood Ave. Arch., S. R. Badgely, of Cleveland, O.

NEW YORK, N. Y.—Plans have been filed by Robt. W. De Forest, 7 North Washington Sq., for a 15-story brick office building at 30 and 36 Broad St., to cost $500,000; A. Costa Nichols, 36 Pierrepont St., Brooklyn, two-story brick electric power house on 12th St., to cost $100,000, and Metropolitan Improvement Co., 146 Broadway, seven-story brick store and flats at 92d St. and the Boulevard, to cost $300,000.

PHILADELPHIA, PA.—The Franklin Institute has had plans prepared for a 12-story building, estimated to cost $1,500,000, including the purchase of the site. Pres., Joseph M. Wilson.

PITTSBURG, PA.—Plans have been prepared for a 12-story brick and stone hotel at Smithfield and Water Sts., estimated to cost $100,000. Arch., V. De Beaumont. Thaddeus Graff is interested.—Bids are asked until May 17 for constructing the department of public safety building, for which bonds were recently voted. Arch., Chas. Bickel, 524 Penn Ave. J. O. Brown, Dir. Dept. Pub. Safety.

WASHINGTON, D. C.—Bids are asked until May 2 for constructing three additional stories over a portion of the building occupied by the Bureau of Engraving and Printing; until May 23 for erecting a post office and custom house at New London, Conn., and until May 24 for excavating, etc., for a post office building at Newburg, N. Y. W. M. Aiken, Supervising Arch.

EDGEFIELD, S. C.—Plans are asked for a three-story brick cotton factory building, one brick or corrugated-iron engine house, one 140-HP. engine and boiler, electric light dynamo, etc., estimated to cost $150,000. Chas. H. Fisher is interested.

NEW ORLEANS, LA.—Plans are asked until May 15 for a new house on Canal St., for the Pickwick Club. The house is to be on a lot 127 x 57 ft. and will be four stories in height, and is not to cost more than $60,000. The best plan will be awarded a prize of $500.

TERRE HAUTE, IND.—Bids are asked until May 15 for constructing a distillery. Press reports state that Justus Riehl, a mechanical engineer, of St. Louis, has been awarded the contract to furnish the plans and specifications for the new distillery. He has but two weeks in which to do the work. Surveys of the ground are being made. The intention is to require the buildings to be completed by Oct. 1. The main building will be 310 x 200 ft., and the next in size 240 x 110 ft. All the buildings, except the cattle sheds, the size of which is not yet determined, will be of brick, with solid stone foundations. The steam plant will be 24 boilers of 100 HP. each.

CHICAGO, ILL.—Handy & Cady are preparing plans for a $120,000 apartment house on Belden Ave., for the Ketcham Lumber Co.—A permit has been granted to the city to construct a brick pest-house at 34th and 35th Sts., to cost $130,000.

MINNEAPOLIS, MINN.—A four-story stone cell house, containing 200 cells 209 x 60 ft., estimated to cost $40,000, is to be built at the state reformatory. Supt., Wm. E. Lee.

RAVENNA, NEB.—C. Seeley, of the Ravenna Flouring Mill, is making arrangements to construct a new elevator of 40,000 bu. capacity.

SANTA CRUZ, CAL.—The supervisors are considering plans for a $40,000 court house.

HALIFAX, N. S.—Bids are asked until May 22 for erecting a drill hall. Engr., C. E. W. Dodwell; E. F. E. Roy, Secy., Dept. Rys. and Canals, Ottawa, Ont.

WATER-WORKS.

BIDDEFORD, ME.—The Biddeford & Saco Water Co. is reported about to put in a new filter plant.

GORHAM, ME.—Frederick Roble has been elected president and I. W. Dyer, treasurer, of the newly incorporated Gorham Water Co.

LISBON FALLS, ME.—The clerk writes us that surveys will be made for works and sewers, but that nothing more will be done this year. J. H. Brewster, Treas.

WATERVILLE, ME.—The Maine Water Co. is reported about to construct a reserve pumping station.

BELLOWS FALLS, VT.—The village corporation has voted to lay a 20 and 16-in. main to the source of the water supply.

SALEM, MASS.—The committee on finance has reported that it would cost about $800,000 to replace the present 45 miles of cement pipe with iron pipe.

WAKEFIELD, MASS.—Capt. W. F. Young, Capt. J. F. Emerson, Dr. D. S. Coles and others are interested in efforts that are being made to secure a better water supply.

EAST PROVIDENCE, R. I.—The East Providence Water Co. has petitioned for a charter to supply water and electricity in Bristol county, R. I., and in adjacent towns in Massachusetts; capital stock, $500,000; incorporators, E. H. Wilson, Benj. Wilson, D. F. Goff and others.

AFTON, N. Y.—It is reported that surveys for works are being made, and that the question of construction will soon be voted upon.

ANTWERP, N. Y.—At a special election April 25 the citizens voted to issue $30,000 in bonds for works.

BUFFALO, N. Y.—Bids are asked until May 8 for rebuilding three pumping engines, and until May 11 for extending an intake tunnel or constructing a new one. R. G. Parsons, Sec. Dept. Pub. Wks.

CENTRAL BRIDGE, N. Y.—F. H. Roundy is reported as making preliminary surveys for works at this place.

CLIFTON SPRINGS, N. Y.—The village trustees are reported as receiving a large number of communications in regard to works and as placing them on file for future reference.

CORNING, N. Y.—An election was held April 30 to vote on an issue of $30,000 in bonds for improving the water system, and $150,000 for building a dike along the Chemung River.

FORT ANN, N. Y.—Engineer Slade, of Glens Falls, has made a preliminary survey for works at this place. E. L. Ashley, of Glens Falls, is interested.

MIDDLEVILLE, N. Y.—It is reported that preliminary surveys for work have been completed, and that the estimates will be ready in a few days.

MOUNT MORRIS, N. Y.—Press reports state that a reservoir and water tower will probably be constructed on Spring Creek, at a cost of $10,000, to supply the Oscar Craig Epileptic Colony at Sonyea, near this place.

ROCHESTER, N. Y.—The water committee has decided in favor of extensions in 36 streets, estimated to cost about $63,000.

SCHENECTADY, N. Y.—Bids are asked until May 23 for the construction of a new water supply system, as stated in our advertising columns. Engrs., the Stanwix Engineering Co., Rome, N. Y. Geo. T. Ingersoll, Supt.

SOUTH OTSELIC, N. Y.—W. E. Davis is reported to have prepared plans for works at this place, to be built by B. F. Gladding & Co.

SYRACUSE, N. Y.—Bids are asked until May 13 for 600 valve boxes. Ch. Engr., W. R. Hill.

WEST TROY, N. Y.—The following bids were received April 25 for constructing works at the Watervliet arsenal: Item 1, construction of water tower, complete, Oscar F. Hilt, $8,448; Edward Kelly, $6,309; John P. Kelly, $6,800; mason work on tower, J. Brennan, $4,400; James Dollard, $5,974; James H. Brennan, $5,645; W. T. Behan, $2,952; Item 2, interior equipment of water tower, with complete filtering plant, Oscar F. Hilt, $1,260; J. P. Kelly, $3,550; Item 3, for water tank, Oscar F. Hilt, $1,699; Franklin Iron Works, $1,550; Item 4, laying cast iron 5-in. force pipe, Oscar F. Hilt, $1,437; John P. Kelly, $1,750; Item 5, laying 5-in. distribution pipe, Oscar F. Hilt, $791; John P. Kelly, $800. Chester Ives' bids for the first four items amounted to $10,164, and O. F. Hilt's to $14,316.

WEST POINT, N. Y.—Bids are asked until May 10 for 3,000 ft. of 6-in. pipe. Capt. J. B. Bellinger, A. Q. M., U. S. A.

WHITE PLAINS, N. Y.—The village trustees have informed the Westchester County Water-Works Co. that the village wishes to acquire ownership in the plant, and it is reported that a committee has been authorized to engage an engineer to prepare plans for a new water supply.

CHATHAM, N. J.—A petition is being circulated asking that an election be held to vote on an issue of $20,000 in bonds for works.

ALLEGHENY, PA.—The contract for about nine miles of 60-in. conduit has been awarded James O'Neil & Bro., of Pittsburg. The steel plates for the pipe will be furnished by the Carnegie Steel Co. and the rivets by the Oliver Iron & Steel Co.

CRESSON, PA.—It is reported that the contract for work will soon be awarded. Dr. Deveraux is interested.

ERIE, PA.—The contract for laying a 60-in. cast iron conduit into the harbor has been awarded to Thacher & Breymann, of Toledo, as noted under our Contract Prices.

LEBANON, PA.—The board of trade is considering new plans for a better water supply. It is also recommended that larger pipe be laid.

MILROY, PA.—A company is being organized to construct works to supply this village with water for fire and domestic purposes from a source 2½ miles distant. S. T. Moore, of Milroy, is the engineer in charge.

MYERSTOWN, PA.—The Myerstown Water Co. has applied for a charter, with a capital stock of $20,000. The proposed supply will be by gravity from springs two miles distant. Pres., Joseph O. Coover, of Myerstown; Engr., Edgar B. Kay, Bellwood, Pa.

PITTSBURG, PA.—A contract for a supply of valves has been awarded to the Ludlow Valve Co. and that for a water tank to Riter & Conley. It is stated that the Brownell Co., of Dayton, O., bid $250 less than Riter & Conley, but that the committee decided to award the contract to local bidders.

PERKASIE, PA.—The Perkasie Water Co. has engaged Potter & Folwell to design a system. The work will be advertised in about two weeks.

READING, PA.—Bids are asked by the water board until May 7 for supplies for the ensuing year.

LAUREL, MD.—Edward Phelps, Mayor, states that it is probable that works will be constructed within the next 12 months and that information and propositions will now be received. John W. Gray, Cy. Clk.

WARRENTOWN, VA.—Press reports state that the reservoir on Watery Mountain, which supplies this town with water, is to be reconstructed at a cost of $3,000.

WAYNESBORO, VA.—Press reports state that bids are being received for the construction of works. Address W. J. Loth.

HUNTINGTON, W. VA.—A special election will soon be held at Central City, near this place, to vote on an issue of $20,000 in bonds for works.

SUMMERVILLE, GA.—Augusta papers state that residents of this suburb are agitating the question of issuing $50,000 in bonds for works. P. O., Augusta.

NEW ORLEANS, LA.—Bids are asked until May 13 for laying about five miles of 6 and 8-in. water pipe, as stated in our advertising columns. L. H. Gardner, Supt. New Orleans Water Co.

LAWRENCEBURG, KY.—Efforts are being made to organize a company to put in works, according to reports.

CARROLLTOWN, O.—At an election April 21 the citizens voted to issue $30,000 in bonds for works, according to reports.

BRAZIL, IND.—Bids are asked until May 18 for reconstructing the works, according to reports. J. McDonald, Cy. Clk.

COLUMBUS, IND.—Levi Hege, Cy. Engr., writes us that the present water supply of about 3,000,000 gallons per day is pumped from the White River, which is polluted with sewage, and that a Chicago party is driving test wells with a view to trying the deep-well system. A good supply could be obtained at a cost of about $40,000, but the present council does not wish to spend that amount, and is figuring on a supply for about $8,000.

DECATUR, IND.—Bids are asked until May 13 for the construction of a complete water-works system, as stated in our advertising columns. Consult. Engr., J. D. Cook, Toledo, O.; Chn. Com., J. S. Coverdale.

CROSWELL, MICH.—This village recently voted to issue $9,000 in bonds for works, but it is stated that a desirable water supply has not yet been secured. John W. Dexter, Clk.

DETROIT, MICH.—The water board is reported about to petition the legislature for authority to issue $2,500,000 in bonds for extensions and for securing a better water supply.

FLINT, MICH.—At a public meeting April 25 the citizens unanimously voted in favor of issuing $150,000 in bonds to secure works to be owned by the city. The present service is said to be unsatisfactory.

HOLLAND, MICH.—A contract for a new pump, etc., has been awarded to the Nordberg Mfg. Co., at $9,230.

STANDISH, MICH.—It is reported that $10,000 in bonds has been voted for water-works and electric lights.

WESTON, MICH.—The question of works is reported as being agitated.

EARLVILLE, ILL.—The contract for constructing works has been awarded to the Challenge Wind Mill & Feed Mill Co., of Batavia, Ill., the Crane compression hydrants to be used.

HILLSBORO, ILL.—The council is considering methods for increasing the water supply.

LATHAM, ILL.—The village board is reported as considering the question of works.

MOUNT PULASKI, ILL.—Bids are asked until May 21 for constructing works, as stated in our advertising columns. Engrs., Harman & Evans, Peoria, Ill. Z. K. Wood, Chn. Com.

QUINCY, ILL.—The council has made a new contract with the Quincy Water Co., and new works will not be constructed.

SHEFFIELD, ILL.—The village clerk requests us to state that the newspaper reports that this place will issue bonds for works is incorrect. The works were completed a year ago.

PRENTICE, WIS.—It is reported that negotiations are pending for putting in works at this place.

POSTVILLE, IA.—Bids are asked until June 1, according to reports, for the construction of works. Wm. Shepard, Cy. Recdr.

HEDRICK, IA.—The council is reported as considering plans for works.

ST. CHARLES, MINN.—At an election April 26 the citizens voted to issue bonds for works.

MARCUS, IA.—The recorder writes us that the Marcus Water-Works Association is constructing works. Benj. Radcliff, Secy.

MOORHEAD, MINN.—Bids are being received for the construction of works and an electric light plant, estimated to cost $25,000. T. I. Lewis, Cy. Recdr.

OWATONNA, MINN.—The council is considering the question of making a change in the pumping system.

WINDHAM, MINN.—It is stated that an election will soon be held to vote on the question of works.

CHANUTE, KAN.—An election will be held May 10 to vote on an issue of $40,000 in bonds for works.

BILLINGS, MONT.—The "Times" of this city states that water-works, electric lights, etc., are to be built at the Crow Agency this summer, at a cost of $40,000.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until May 17 for a quantity of pipe, castings, hydrants, valves, etc., and for laying 43,200 ft. of pipe.

ALVARADO, TEX.—Bids are asked by the Alvarado Water Supply & Light Co. for sinking an artesian well. The organization of this company was noted in our issue of April 18. J. W. Stark, Secy.

GOLIAD, TEX.—A 30-year franchise has been granted to the Goliad Water & Light Co. H. B. Campbell, Treas.

PALMER, TEX.—A company has been organized with a capital stock of $10,000, to sink an artesian well.

STEPHENVILLE, TEX.—The board of trade and the city council are making efforts to secure a combined water-works, ice and electric light plant.

BALLARD, WASH.—Local papers state that a contract for boring six wells has been awarded to the Northwest Artesian Well Co., of Seattle, and that the contract for pipe, valves, hydrants, etc., and for the construction work has been awarded to John Martin, of San Francisco, representing the Anniston Pipe & Foundry Co., of Anniston, Ala., at $23,763. The contract for special castings was awarded to the West Coast Iron Works, of Ballard.

HOOD RIVER, ORE.—The Hood River Spring Water Co. has been incorporated with a capital stock of $12,000, by A. S. Blower, W. M. Yates and N. Blower.

DIGBY, N. S.—The contract for constructing the works has been awarded to Messrs. Wood, of Bridgeville, at $14,409.

TORONTO, ONT.—An election will be held May 25 to vote on an issue of $135,500 in bonds for a 36-in. main to the Rosehill reservoir. John Blevins, Cy. Clk.

IRRIGATION.

ST. JOHNS, ARIZ.—It is reported that the people have constructed on the Little Colorado River, at a cost of $10,000, a storage reservoir covering 840 acres, with water 18 ft. deep, and that they are now figuring on the construction of another reservoir in the same valley to cost $50,000.

GUNNISON, UTAH.—Press reports state as follows: A canal is being surveyed from the reservoir south of Manti to Willow Creek, a distance of 15 to 20 miles. It is estimated that the canal will reclaim over 7,000 acres of choice farming land. The canal will be from 12 to 16 ft. on the bottom, and will carry a volume of water about 2 ft. in depth. The source of supply will be the Gunnison reservoir, which contains a body of water over four miles in length, nearly one mile in width, and with a depth of 20 ft. It is proposed to raise the dam in the Sanpitch River about 5 ft., in order to double the present capacity. This reservoir now supplies several thousand acres of grain and alfalfa land in the vicinity of Gunnison.

NEW COMPANIES.—Mirage Irrigating Co., Sheridan county, Neb.; $50,000; to construct irrigating ditches, taking the water from the Niobrara River in Dawes county; Jules E. Tissot, G. H. Drefur, Henry Koch, Alfred Johnson and others.

Taboose Land Water Co., Independence, Cal.; $5,000, with $500 paid in; to construct canals and ditches for irrigating purposes: Mrs. A. Calloway, S. D. Tapman, Mrs. F. M. Smith, L. E. Smith, J. W. Calloway.

Liberty Ditch Co., Independence, Cal.; $200,000, with $10,000 paid in; to construct irrigating ditches and canals; William Breeding, James A. Partridge, Benjamin Yandell, J. G. Smith Benjamin Martin, Independence.

SEWERAGE.

BAR HARBOR, ME.—Bids are asked by the selectmen until May 4 for constructing about 4,750 ft. of pipe sewers. Engrs., Savage & Lord.

PORTLAND, ME.—The commissioner of public works has decided to rebuild the Emery St. outlet sewer, at an estimated cost of $3,000.

DOVER, N. H.—The construction of a brick sewer in Washington St., estimated to cost $7,000 to $10,000, is being considered.

LAWRENCE, MASS.—A. D. Marble, Cy. Engr., has prepared estimates for constructing a 66 to 48-in. brick sewer 5,400 ft. in length, estimated to cost $164,000 to $200,000.

MEDFORD, MASS.—The lowest bids received April 27 for the construction of section 16 of the system was that of H. A. Hanscom & Co., of Everett, Mass., at $37,994. The itemized bids will probably be published next week.

MELROSE, MASS.—It was voted at a town meeting April 25 to issue $100,000 in bonds for sewers. The system when completed will be about 52 miles in length.

ALBANY, N. Y.—Bids are asked until May 6 for constructing an 84 to 30-in. brick and 20 and 15-in. pipe sewer as an extension to the Beaver Creek sewer. Thos. J. Lanahan, Clk. Bd. of Contract.

BROOKLYN, N. Y.—Bids are asked until May 8 for constructing sewers in seven districts. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids are asked until May 7 for constructing 15 to 104-in. pipe sewers in three streets. R. G. Parsons, Secy. Dept. Pub. Wks.

ROCHESTER, N. Y.—Bids are asked until May 6 for constructing sewers in two streets and for improving portions of five streets. T. J. Neville, Clk.

NEW BRUNSWICK, N. J.—The aldermen have voted to construct a sewer in George St.

RED BANK, N. J.—The citizens have voted to construct a system. An election will soon be held to vote on the amount to be appropriated.

WESTFIELD, N. J.—F. A. Dunham, of Plainfield, writes us that Stratford & Hawkes, of Brooklyn, have been awarded the contract for constructing the lateral sewers, at $24,234. The itemized bids were published April 25.

PITTSBURG, PA.—Bids are asked until May 10 for constructing nine 24 to 15-in. pipe sewers. E. M. Bigelow, Dir. Pub. Wks.

BALTIMORE, MD.—Bids are asked until May 13 for furnishing materials for a sewer in Luzerne St. A. E. Smyrk, Cy. Comr.

BIRMINGHAM, ALA.—The city engineer has been directed to advertise for bids for constructing sewers in the south side.—The construction of sewers in several streets, at an estimated cost of $100,000, is being considered.

CHILLICOTHE, O.—The council will soon decide upon a plan for a main sewer in Paint St., with laterals in three streets, as a beginning of a system.

CINCINNATI, O.—Bids are asked by the board of administration until May 11 for constructing sewers in Conroy St., at an estimated cost of $45,000.

LOGAN, O.—Bids are asked until May 9 for the purchase of $60,000 of 5% bonds.

GREENFIELD, IND.—Phillips & Goss, of Martinsville, have nearly completed plans for a system, part of which will probably be built this year.

INDIANAPOLIS, IND.—Bids are asked until May 7 for about 9,025 ft. of 15 and 8-in. pipe, and 48 to 32-in. brick sewers. Chas. C. Brown, Cy. Engr.

MATTOON, ILL.—Bids will be asked in about two weeks for $7,000 worth of pipe sewers. M. B. Fitch, Cy. Engr.

PEORIA, ILL.—Walter C. Parmley, First Asst. Engr., writes us that the T. B. Townsend Brick & Contracting Co., of Zanesville, O., has been awarded the contract for constructing the West Bluff system, advertised in Engineering News. The itemized bids are published under Contract Prices.

QUINCY, ILL.—It is reported that the incoming council will probably change the plans for a system in the northern part of the city and adopt the separate system.

DES MOINES, IA.—Bids are asked until May 6 for constructing about 1,350 ft. of 49-in. brick sewer in Birds Run. Edward Wright and John Sherman, Bd. Pub. Wks.

DUBUQUE, IA.—The committee has recommended the construction of a sewer in West Fifth St.

ST. LOUIS, MO.—The Hill-O'Meara Construction Co. was the lowest bidder for a sewer in Pine St., at $6,612, and in Lake Ave., at $3,858.

WACO, TEX.—Bids are asked until May 19 for constructing 14,500 ft. of 15 to 8-in. pipe sewers. C. C. McCulloch, Mayor; R. W. Jablonowski, Cy. Secy.

GARBAGE DISPOSAL.

BRIDGEPORT, CONN.—The Bridgeport Utilization Co. has been organized, and is reported to have been awarded the contract for collecting and disposing of the garbage of the city, at 34 cts. a ton.

BROOKLYN, N. Y.—Bids were received April 30 for collecting and removing garbage from Wards 29 and 30 until Jan. 1, 1896. Alfred T. White, Comr. Cy. Wks.

BURLINGTON, IA.—The Burlington Fertilizer Co. has been organized, with a capital stock of $5,000, to secure the contract for disposing of the garbage of this city, according to reports. John M. Mercer, Attorney.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until May 6 for furnishing paving brick to the street department from May 15 to Feb. 1, 1896. B. T. Wheeler, Supt. Sts.

TAUNTON, MASS.—Bids are asked until May 6 for 7,000 sq. yds. granite paving. J. H. Church, Supt. Sts.

PROVIDENCE, R. I.—Bids are asked until May 4 for grading 1,900 lin. ft. of Douglas Ave. in North Providence. Thomas H. Angell.—Bids are asked until May 7 for 4,200 sq. yds. of granite block paving and 27,300 sq. yds. of Trinidad asphalt paving. Robt. E. Smith, Comr. Pub. Wks.

ALBANY, N. Y.—Bids are asked until May 6 for paving portions of two streets with granite blocks. Thos. J. Lanahan, Clk. Bd. Control.

BUFFALO, N. Y.—Bids are asked until May 14 for paving portions of three streets with Trinidad Lake asphalt, etc. R. G. Parsons, Secy. Dept. Pub. Wks.

GENEVA, N. Y.—The legislature is reported about to be petitioned to grant authority for this town to pave the streets, at an estimated cost of $20,000 a mile.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements, 2622 Third Ave., until May 9 for paving two streets with granite blocks and for improving two streets.

ALLEGHENY, PA.—The council has been petitioned to repave portions of 10 streets in Ward 4.

LAUREL, MD.—John W. Gray, Clk., writes us that the following bids were received April 22 for improving Washington Ave.: Owen Patterson, Baltimore, $14,645; Wm. E. Anderson, Baltimore (awarded contract), $11,300; Milstead & O'Brien, Laurel, $15,000; Knight & Mullin, Washington, D. C., 12-in. macadam, $31,115; 9-in. macadam, $12,047.

MERIDIAN, MISS.—The citizens have voted to issue $105,000 in 6% bonds for paving and sidewalk improvements.

SOMERSET, KY.—The Southern Contracting Co., of Chattanooga, Tenn., has been awarded the contract for 10,000 lin. ft. of brick sidewalks. J. H. Wheelock, Cy. Clk.

CHILLICOTHE, O.—It is proposed to pave portions of three streets.

CINCINNATI, O.—Bids are asked by the board of administration until May 10 for paving two streets with brick.

CLEVELAND, O.—Bids are asked until May 11 for grading and paving the north and south approaches to the Columbus Ave. bridge with Medina sandstone. D. E. Wright, Dir. Pub. Wks.

FOSTORIA, O.—Bids are asked until May 20 for improving North Main St. J. M. Schatzel.

SALEM, O.—Bids are asked until May 21 for the purchase of $4,800 of 6% paving bonds, and for 3,076 sq. yds. of brick paving on Main St. F. W. Allison, Cy. Clk.

FRANKFORT, IND.—Bids are asked until May 21 for 22,000 sq. yds. of brick paving, as stated in our advertising columns. Alonzo J. Hammond, Cy. Engr.

HAUGHVILLE, IND.—Bids are asked until May 15 for paving several streets with artificial stone and brick, according to reports. William Greiner, Pres. Bd. Town Trustees.

INDIANAPOLIS, IND.—Bids are asked until May 7 for 15,535 sq. yds of asphalt paving on 6 ins. Portland cement concrete foundation, 4,319 ft. of curb, etc. C. C. Brown, Cy. Engr.—Resolutions have been adopted for 3,000 lin. ft. of cement sidewalks.—Plans have been ordered for 800 ft. of cement sidewalks and 2,800 ft. of asphalt on two streets.

ALPENA, MICH.—The county clerk has advertised for bids for the purchase of $100,000 in bonds for improving the roads of Alpena county.

GRAND RAPIDS, MICH.—The paving of Waverly Place with asphalt is being considered.

LUDINGTON, MICH.—Bids are asked until May 7, 8, 9, 10, 13, 14 and 15, for grading and miscellaneous county contracts. A. B. Hunter, Chn. Comrs.

MATTOON, ILL.—Bids will be asked in about two weeks for paving three streets, 32,340 sq. yds., with brick, and one street, 11,000 sq. yds., with Telford macadam. M. B. Fitch, Cy. Engr.

SEATTLE, WASH.—The council has been petitioned to pave a portion of Second St. with brick, with granite curbing, at an estimated cost of $50,000.

CONTRACT PRICES

DRAINAGE DITCH.—Lincoln, Ill.—The contract for a drainage ditch, to cost about $15,000, and to reclaim about 1,000 acres of land in the southern part of Logan county, has been awarded to Geo. Brott, Decatur, Ill., at 7⅝ cts. per cu. yd., the bids being as follows: A. V. Wills & Sons, 8½ cts.; H. T. Aspern & Son, 7 9-10 cts.; John Kissell, 6 cts.; George Brott, 7⅝ cts.; Belverner & Co., 7 9-10 cts.; Galloway & Gasaway, 10 9-20 cts.

SEWERS.—Williamsport, Pa.—Geo. D. Snyder, Cy. Engr., informs us that the itemized bids received April 18 for constructing sewers were as follows; contract awarded to A. H. Coon & Sons, as noted in our issue of April 25 under Sewerage:

Bids Received at Williamsport, Pa., April 18, for Constructing Sewer.

Quantities.		A. H. Coon & Sons.	Ward & Slucker.	David P. Guise.	Sanders & Houston.	J. Hanna & E. W. Reilley.	Jas. McCloud & Co.	Bowman Bros.	John C. Schrade.
20-in. pipe,	2,100 ft.	$1.39	$2.39	$2.15	$2.19	$1.40	$2.25	$1.75	$2.43
18-in. "	3,715 "	.785	1.16	1.05	1.11	1.03	.95	1.18	1.21
12-in. "	1,520 "	.485	.46	.72	.64	.75	.69	.69	.65
10-in. "	7,500 "	.47	.48	.53	.53	.74	.57	.61	.68
8-in. "	2,775 "	.41	.37	.50	.46	.65	.45	.43	.54
Manholes,	45...	30.00	32.00	35.00	37.50	30.00	40.00	35.00	45.00
Flushtanks,	per cu.yd.	4.50	8.00	13.60	15.00	100.00	14.50	7.50	8.50
Lampholes,	5...	9.00	5.00	10.00	4.75	7.00	6.00	10.00	20.00
Concrete	per cu. yd.	4.50	4.00	6.00	6.50	3.00	5.50	5.00	5.50
Extra brickwork	" " "	13.50	8.00	16.00	15.00	2.80	14.50	7.50	7.20
Drain tile laid	per ft.	.09	.10	.10	.11	.05	.12	.10	.07
House connections	...	.24	.25	*.35	.55	.30	.50	*.45	.60
20-in. x 6-in. Y's	105...	1.19	2.09	2.20	2.11	1.09	3.25	1.35	2.75
18-in. x 6-in. "	184...	1.12	1.57	1.72	1.75	1.27	2.30	1.30	1.85
12-in. x 6-in. "	100...	.25	.58	.65	.70	.64	1.00	1.25	.65
10-in. x 6-in. "	534...	...	.44	.48	.48	.49	.75	1.20	.56
8-in. x 6-in. "	306...	...	.31	.35	.34	.34	.50	1.15	.42
Total		$13,606	$17,385	$17,973	$18,092	$18,136	$18,524	$18,617	$20,971
Aggregate bid		15,160	17,385	17,973	18,092	18,939	18,524	18,617	20,971

* And 40 cts.

CAST IRON PIPE.—Lowell, Mass.—The water board has awarded a contract for 150 tons of cast iron pipe to the Anniston Pipe & Foundry Co., Anniston, Ala., at $19.70 per ton.

BRICK PAVING.—Fort Wayne, Ind.—A. J. Yon, Clk. Bd. Pub. Wks., writes us that a contract for 6,500 sq. yds. of brick paving upon a foundation of 6 ins. of broken stone, with grout filler, has been awarded to T. B. Emple, at $5.19 per lin. ft. complete for a street 28 ft. wide.

CAST IRON PIPE AND CASTINGS.—Cincinnati, O.—The following bids were received April 23 for water pipe and castings: Howard-Harrison Iron Co., Bessemer, Ala., $24 per ton for pipe; $60 per ton for specials and $80 per ton for loam castings; Dennis Long & Co., Louisville, Ky., $23.14, $54 and $100; Anniston Pipe & Foundry Co., Anniston, Ala., $22.50, 2⅝ cts. per lb., and 3½ cts. per lb.; Chattanooga Foundry & Pipe Wks., Chattanooga, Tenn., $23.45, 2⅝ cts. and 3½ cts.; Addyston Pipe & Steel Co., Cincinnati, O., $22.95, $52 and $80.

RAILWAY GRADING.—Denver, Colo.—F. Trumbull, Receiver, has awarded the contract for grading the Union Pacific, Denver & Gulf Ry. extension from Forbes, near Trinidad, to Walsenburg, Colo., to A. Sheridan, of St. Joseph, Mo., at 8¼ cts. per cu. yd. for earth work, 55 cts. for blasting rock, 25 cts. for loose rock. The contract specifies that work must begin within five days and a full force be kept in the field all the time.

SEWERS.—Champaign, Ill.—J. P. Dunlap, Cy. Engr., informs us that the following bids were received April 17 for constructing a system of sewers, as advertised in Engineering News:

BIDS RECEIVED AT CHAMPAIGN, ILL., APRIL 17, FOR CONSTRUCTING A SEWER SYSTEM.

Quantities.		Mansfield & Allen, Indianapolis, Ind.	Wm. Davy & Son, Chicago, Ill.	J. H. Roche & Co., Chicago, Ill.	T. B. Townsend Co., Zanesville, Ohio.	Geo. S. Miller Co., Ottawa, Ill.	Toledo Const'n Co., Toledo, Ohio.	J. W. Wilding & Co., Indianapolis, Ind.	Campbell, Dennis & Co., Joliet, Ill.	Hanlon & Knepper, Sioux City, Iowa.	C. H. Defrees & Co., South Bend, Ind.	G. B. Keller, 84 Lasalle St. Chicago, Ill.	Penney-Myers Construction Co., St. Louis.
20-in. pipe	13,000 ft.	$0.54	$0.45	$0.48	$0.50 6-10	$0.48	$0.40	$0.45	$0.53	$0.47	$0.42	$0.47	$0.53
18-in. "	2,300 "	.33½	.37½	.45	.37	.36	.39	.33	.41	.37½	.36 6-10	.39	.37
15-in. "	1,200 "	.22½	.22	.27	.30	.23	.25	.22	.29	.23½	.21½	.28	.26
14-in. "	1,500 "	.20½	.19	.30	.30	.21	.25	.20	.25	.22½	.20 68-100	.27	.24
12-in. "	5,000 "	.16⅝	.16	.19	.24	.18	.17	.19	.21	.19	.14½	.20	.20
10-in. "	5,200 "	.12⅝	.13½	.15	.21	.14	.12	.13	.17	.14	.11½	.15	.14
8-in. "	44,000 "	.09	.09	.10	.15 4-10	.10	.08⅜	.09	.10	.11	.07 64-100	.09	.09½
6-in. "	86,000 "	.06 15-100	.06¼	.06	.13 2-10	.07	.05⅞	.06	.08	.06	.05 43-100	.07	.06⅞
Laying and cementing 20-in. pipe	13,000 "	.04½	.12	.02½	.03½	.05	.09	.04	.02	.06½	.04½	.10	.08
" " " 18-in. "	2,300 "	.04	.10	.02½	.03½	.05	.08	.04	.02	.06	.04¼	.10	.07½
" " " 15-in. "	1,200 "	.03½	.08	.02	.03½	.04	.07	.04	.02	.04	.04	.10	.06
" " " 14-in. "	1,500 "	.03½	.08	.02	.02¾	.04	.07	.04	.01½	.04	.03¾	.10	.06
" " " 12-in. "	5,000 "	.03½	.07	.02	.02 1-5	.04	.06	.03	.01½	.03	.03¼	.08	.05
" " " 10-in. "	5,200 "	.03	.06	.02	.02 1-5	.03	.06	.03	.01½	.03	.03	.05	.05
" " " 8-in. "	44,000 "	.02½	.05	.01½	.01⅔	.02	.06	.03	.01½	.02	.02½	.04	.04
" " " 6-in. "	86,000 "	.01¼	.02½	.01¼	.01⅔	.02	.04	.03	.01½	.01½	.01½	.03	.03
Excavation and backfilling under 6 ft.	9,600 "	.07 87-100	.09	.08	.08 4-5	.06	.15	.20	.13	.15	.08	.13	.07
" " " " 6 to 8 "	81,300 "	.12	.14	.10	.08 4-5	.12	.17	.25	.15	.15	.14	.16	.11
" " " " 8 " 10 "	44,000 "	.19	.20	.16	.13⅞	.16	.28	.32	.20	.19	.17	.20	.20
" " " " 10 " 12 "	12,900 "	.32	.30	.22	.17	.22	.40	.42	.22	.25	.20	.26	.27
" " " " 12 " 14 "	6,000 "	.45	.40	.28	.22½	.32	.47	.45	.33	.29	.31	.30	.36
" " " " 14 " 16 "	1,200 "	.60	.60	.34	.28	.40	.62	.53	.44	.33	.44	.40	.46
" " " " 16 " 18 "	300 "	1.20	.80	.40	.30	.47	.70	.60	.55	.43	.54	.55	.82
" " " " 18 " 20 "	200 "	1.40	1.00	.40	.36	.60	.80	.70	.66	.48	.70	.60	1.00
Repaving	2,000 "	.05	.10	.12	.05½	.10	.25	.15	.03	.05	.10	.10	.15
Embankment	5,000 cu. yds.	.20	.25	.27	.22 1-5	.11	.35	.29	.16	.18	.20	.15	.13
Embankment hauled	500 " "	.25	.01	.12	.02	.02	.25	.05	.02	.07	.02	.02	.01
20-in. iron pipe	2 tons...	40.00	27.00	24.95	26.64	30.00	25.00	30.00	27.80	25.00	23.00	30.00	23.00
12-in. " "	5 " ...	40.00	22.50	23.42	26.64	30.00	25.00	30.00	27.60	25.00	22.00	30.00	25.00
10-in. " "	—.....	40.00	22.50	33.57	26.64	30.00	25.00	28.00	27.60	25.00	22.00	30.00	26.00
8-in. " "	4 tons...	40.00	22.50	33.70	26.64	30.00	25.00	28.00	27.54	25.00	21.50	30.00	27.00
6-in. " "	4 " ...	40.00	22.50	33.70	26.64	30.00	25.00	28.00	25.98	25.00	21.50	25.00	28.00
Manholes	150.....	25.00	25.00	17.50	26.64	29.00	35.00	30.00	16.50	23.50	20.00	22.00	24.50
Flushtanks	50.....	30.00	35.00	28.00	26.64	36.00	40.00	35.00	19.80	30.00	32.00	37.00	26.00
Lampholes	150.....	7.00	4.60	4.00	3.33	5.00	5.00	7.00	4.40	5.00	3.83	4.00	4.00
Brick masonry	20 cu. yds.	8.00	9.00	8.00	6.66	7.00	12.00	7.00	6.15	10.00	7.60	8.00	6.00
Stone masonry	15 " "	10.00	12.00	7.00	11.10	8.00	10.00	14.50	9.65	10.00	7.50	9.00	6.00
Excavation	1,300 " "	.16	.20	.18	.16⅔	.12	.50	.25	.08	.20	.10	.15	.15
Concrete	100 sq. yds.	1.25	3.50	2.75	.67	.60	6.00	1.10	.55	3.00	.80	.60	1.00
Brick	per M..	8.00	9.00	8.00	6.66	7.00	12.00	7.00	6.15	10.00	...	8.00	6.00
Tiling	4,000 ft.....	.07	.05	.03½	.06⅔	.06	.10	.08	.04	.10	.03½	.07	.06
Totals		$58,483	$62,664	$50,404	$58,094	$55,233	$74,768	$78,375	$58,101	$58,238	$51,947	$63,253	$58,857

EXCAVATION, ETC.—Boston, Mass.—W. E. Swan, Secy. Water Bd., writes us that contracts for excavating soil and shallow flowage and building roads at Basin No. 5 of the Boston water-works were awarded as follows: Section B, to Newell & Snowling, of Uxbridge, Mass., earth excavation, 194,000 cu. yds., at 37 cts.; split-stone masonry, laid dry, 510 cu. yds., $10.50; paving, laid in mortar, 102 cu. yds., $8; American cement concrete, 228 cu. yds., $4; dry rubble masonry, 278 cu. yds., $4; riprap, 4,480 cu. yds., $1.50, stone wall, 120 rods, $3. Section C, to Malone & Strang, Boston, earth excavation, 311,000 cu. yds., at 21 cts.; split-stone masonry, laid dry, 536 cu. yds., $10; paving laid in mortar, 102 cu. yds., $5; American cement concrete, 231 cu. yds., $5; dry rubble masonry, 345 cu. yds., $5; riprap, 8,640 cu. yds., 75 cts.; stone wall, 540 rods, $3. Section D, to Malone & Strang, earth excavation, 211,000 cu. yds., at 25½ cts.; split-stone masonry, laid dry, 1,310 cu. yds., $10; paving laid in mortar, 217 cu. yds., $5; American cement concrete, 363 cu. yds., $5; dry rubble masonry, 145 cu. yds., $5; riprap, 6,580 cu. yds., 75 cts.; stone wall, 120 rods, $3. Section E, to Chas. Lineham, of Cambridgeport, earth excavation, 209,000 cu. yds., 23 cts. Section F, to Newell & Snowling, earth excavation, 177,000 cu. yds., at 26 cts. Section G, to Chas. Lineham, earth excavation, 129,000 cu. yds., at 19 cts. Section H, to Moulton & O'Mahoney, of Boston, earth excavation, 181,000 cu. yds., at 26 cts. The total bids for sections C and D were as follows:

	Section C.	Section D.
Malone & Strang, Boston	$82,160	$75,825
Chas. McDermott, Brockton	92,960	.....
Wm. H. Magee, West Newton	95,241	.....
Newell & Snowling, Uxbridge	108,036	75,704
Michael Effie & Co., Boston	108,902	.....
Chas. Lineham, Cambridgeport	110,677	.....
Gennaro, Long & Little, S. Br'tree	116,049	93,593
Moulton & O'Mahoney, Boston	118,298	88,887
Rowe & Hall, Boston	119,725	101,149
McCarthy Bros, Franklin	123,873	99,887
Hendrick, Taylor & Warner*	151,505	88,486
H. P. Nawn, Boston	171,189	126,714
W. T. Davis & Co., Boston	.....	88,060
Roxbury Granite Co., Keene, N. H.	.....	89,625
McNiece, Cuozzo & Co., New York	.....	103,922
Saucier & Cronin, Boston	.....	105,297

* Northampton.

BRICK PAVING.—Waukegan, Ill.—The contract for 15,300 sq. yds. of paving with one course of brick upon 6 ins. macadam and 2 ins. gravel, as advertised in Engineering News of March 14 and 21, has been awarded to the Rockford Construction Co. for Streator brick. The itemized bids received, the bid for Streator brick only and only the lowest bid for curbing being given, were as follows; Engr., H. W. Large:

ASPHALT PAVING.—Newport, R. I.—J. P. Cotton, St. Comr., writes us that the only bid received April 12 for repaving Thames St. with Trinidad Lake asphalt was that of the Narragansett Improvement Co., Providence, R. I., at $2.76 per sq. yd., or $2.63 to use a specified sand instead of stone dust; contract awarded at $2.63. This work was not advertised in Engineering News.

Bids Received at Waukegan, Ill., April 2, for Brick Paving.

Bidder.	Excavation, 3,595 cu.yds.	New catchbasins, 4.	Catchbasins reset, 18.	Inlets reset, 10.	Manhole covers reset, 18.	Curbing, 4,425 lin. ft.	Paving, 15,300 sq. yds.	Header, 123 ft.	Gutter bridges 38.	Total.
Rockford Construction Co., Rockford	$0.24	$30.00	$2.00	$1.00	$1.00	$0.49	$1.144	$0.10	$2.00	$20,867
M. L. McCarron, Detroit, Mich.	.12	34.00	4.00	3.00	3.00	.49	1.14	.15	5.00	20,853
Philip Sampson, Waukegan	.18	45.00	18.00	10.00	5.00	.44	*1.14	.43	7.00	21,307
J. B. Smith & Co., Chicago	.18	30.00	2.00	2.00	2.00	.50	1.20	.06	1.00	21,513
W. M. Campbell, Menominee, Mich.	.30	34.00	4.00	.50	1.00	.48	1.225	.06	3.00	22,332
M. C. Burke, Chicago,	.17	35.00	10.00	5.00	7.50	.47	1.25	.10	5.00	22,583
C. & T. Iglehart, Morgan Park	.15	29.00	2.25	2.25	2.25	.51	1.29	.19	7.50	23,175
H. G. Myrick, Morgan Park	.22	25.00	2.50	2.50	2.00	.53	1.38	.53	5.00	25,029
J. A. Donohue, Chicago	.27	17.25	1.72	1.72	1.72	.51	1.31	.08	10.00	23,856
W. F. Hair, Chicago	.10	20.00	3.00	3.00	3.00	.50	1.44	.06	4.00	25,017
Moritz Stuede, Chicago	.18	42.00	10.00	6.00	7.00	.54	*1.59	.28	8.00	28,404
James O'Loughlin, Chicago	.25	20.00	5.00	5.00	2.00	.48	1.42	.20	8.00	25,630
James Cape & Sons, Racine, Wis.	.20	40.00	3.00	2.00	1.00	.47	1.29	.25	4.00	23,120
Henry Besley, Cedar Rapids,	.24	32.50	4.00	2.50	1.50	.54	1.305	.15	6.50	23,828
Fr. Laing, Highland Park	.20	35.00	2.00	1.50	2.00	.49	1.29	.20	3.50	23,129
Casgrain & McDonald, Chicago	.25	23.50	1.25	1.00	1.25	.57	**1.38	.10	4.00	24,908
Garden City Paving & Post Co., Chicago	.20	30.00	3.00	1.00	2.00	.55	1.295	.14	4.00	23,550
Gaffney & Long, Chicago	.20	35.00	.01	.01	.01	.45	1.37	.12	4.00	24,050
Campbell & Dennis, Joliet	.20	30.00	3.00	2.00	2.00	.49	1.295	.125	3.50	23,154
N. F. Reichart & Co., Racine	.22	30 00	5.00	1.50	3.00	.52	*1.37	.08	2.50	24,485
Talbot Paving Co., Chicago	.13	18.00	1.00	1.00	1.00	.49	1.41	.12	8.00	24,939
South Bend Const'n & Imp'v't Co., So. Bend, Ind.	.17	28.34	3.00	1.50	1.50	.49	1.37	.12	2.50	24,152
Sackley & Peterson, Chicago	.20	20.00	2.00	1.50	2.00	.60	1.31	.10	7.00	23,922
Wm. Forestal & Son, Milwaukee,	.30	25.00	15.00	12.00	4.00	.48	1.31	.10	5.00	24,070
J. A. Barris & Co., Chicago,	.22	24.00	2.00	1.00	1.00	.50	1.29	.15	3.50	23,407
R. F. Conway, Chicago	.30	25.00	2.00	1.50	1.50	.55	1.45	.12	7.00	26,228
A. Anderson, Chicago	.15	25.00	7.50	2.00	3.00	.60	*1.40	.15	5.00	25,222
J. Robinson, Chicago	.25	26.00	1.00	1.00	1.00	.62	**1.59	.25	9.00	24,642
James Bairstow, Chicago	.29	25.00	3.00	3.00	3.00	.53	*1.29	.15	2.50	23,566
Patterson & Streffler, Springfield	.18	25.00	3.00	3.00	3.00	.49	1.29	.10	4.00	23,015
Engineer's estimate	.30	30.00	2.50	1.00	2.50	.52	1.30	.15	4.00	23,760

* Galesburg; no bid on Streator brick. ** Purington; no bid on Streator brick.

STONE PAVING.—Cincinnati, O.—The contract for paving Vine St., from Hollister St. to First Angle South, has been awarded to J. M. Quill. We are informed that the bids were as follows, all the bidders being residents of Cincinnati; estimated cost, $10,653.

Quantities	Kirschner & Folz.	J. A. Eberhardt.	J. M. Quill.
Granite curbs, 1,170 lin. ft.	$1.10	$1.00	$0.90
Granite c'bs, circular, 30 lin. ft.	1.60	1.75	0.01
Curbs, reset, 20 lin. ft.	.20	.01	.01
Crossings, 100 lin. ft.	1.00	.90	.01
Grading, 1,000 cu. yds.	.01	.01	.01
Granite paving, 2,200 sq. yds.	2.60	2.70	2.80
Concrete, 375 cu. yds.	3.25	2.80	2.70
Rolling, 2,230 sq. yds.	.05	.03	.01
Relaying gutters, 20 lin. ft.	.20	.01	.01
Resetting manholes, 3.	1.50	1.00	.01
Rebowidering, 10 sq. yds.	.70	.50	.01
	$8,515	$8,388	$8,365

INTAKE PIPE EXTENSION.—Erie, Pa.—The contract for dredging and laying a 60-in. cast iron conduit into the harbor has been awarded to Thacher & Breymann, of Toledo, O., at $6.30 per ft. Hingston & Wood, Buffalo, bid $6.50; Shailer & Schniglau Co., Chicago, $7.30; Buffalo Dredging Co., Buffalo, $8.50. There will be 8,200 ft. of iron pipe to lay and it will have to be sunk several feet below the level of the bay bottom so as not to afford a possible obstruction to navigation. The proposed terminal of the intake will be in 26 ft. of water in Big Bend, 3,700 ft. from the south shore of the peninsula. The contract also includes the construction of the necessary cribwork at the source of the supply. The work is to be completed by Dec. 31, 1895.

SEWERS.—Peoria, Ill.—The total bids received April 11 for constructing the West Bluff sewer system, as advertised in Engineering News, were published in our issue of April 18. Walter C. Parmley, Des. Engr., who has charge of the work, writes us that owing to a systematic error the totals were not reported correctly at first. The contract has been awarded to the T. B. Townsend Brick Contracting Co., Zanesville, O., the itemized bids being as follows:

DREDGING.—San Francisco, Cal.—The following bids were received by W. H. Heuer, U. S. Engineer Office, April 18 for dredging in Petaluma Creek, Cal.: Pacific Coast Dredging Co., 15 cts. per cu. yd.; A. W. Von Schmidt, 10 cts.; both bidders of San Francisco.

SEWERS.—Waukegan, Ill.—H. W. Large, Engr., writes us that the following bids were received April 15 for constructing the Spring St. sewer, the contract being awarded to the N. F. Reichart Co.:

Bids Received at Waukegan, Ill., for Constructing Spring St. Sewer.

Bidder.	18-in. sewer, Cut, 11 ft. 6 ins., 165 ft.	18-in. sewer, Cut, 11 ft., 663 ft.	18-in. sewer, Cut, 8 ft. 2 ins., 498 ft.	18-in. sewer, Cut, 6 ft., 710 ft.	Manholes, 7.	Catchbasins, 16.	Comb. c.-b. and m'hole, 1.	Total.
C. & J. Iglehart, Morgan Park, Ill.	$1.23	$1.29	$1.03	$0.85	$19.00	$29.00	$40.00	$2,812.00
J. A. Roche & Co., Chicago, Ill.	1.10	1.00	.89	.77	23.00	26.00	45.00	2,457.21
The N. F. Reichart Co., Racine, Wis.	.80	.75	.70	.65	28.00	28.00	30.00	2,113.97
Andrew Maloney, Chicago, Ill.	1.10	1.05	.90	.71	20.00	25.00	25.00	2,395.74
Fr. Laing, Highland Park, Ill.	1.50	1.30	1.10	1.00	25.00	35.00	35.00	3,138.22
Michael McElligott, Evanston, Ill.	1.20	1.10	.85	.73	22.00	32.00	37.00	2,572.71
William Hallowell, Jr., Waukegan, Ill.	1.74	1.16	.91	.77	26.00	36.50	60.00	2,882.91
McNulty & McCarthy, Chicago, Ill.	1.00	1.00	.90	.85	16.00	18.00	25.00	2,305.52
William Davidson, Mattoon, Ill.	1.30	1.20	.90	.70	20.00	25.00	40.00	2,536.14
H. D. Hallett, Aurora, Ill.	1.50	1.00	.90	.80	25.00	25.00	45.00	2,547.52
W. M. Campbell, Menominee, Wis.	1.00	.91	.72	.70	24.00	25.00	30.00	2,218.59
Fox & Yeager, Waukegan, Ill.	1.35	1.30	1.25	1.20	28.00	32.00	48.00	3,316.27
Engineer's estimate	1.55	1.22	.91	.80	28.00	36.50	73.00	2,939.67

CAST IRON PIPE, ETC.—Augusta, Ga.—A. H. Davidson, Cy. Engr., writes us that a contract for 120 tons of 6-in., 6 tons of 4-in. and 2 tons of 20-in. cast iron pipe has been awarded to the Chattanooga Foundry & Pipe Works, at $18.80 per ton of 2,000 lbs., and also a contract for 6,000 lbs. of special castings at 2 cts. per lb. C. A. Roble, of Augusta, was awarded a contract for hydrants, valves and pipelaying, as follows: 15 fire hydrants, one 2½-in. nozzle, 3 ft. under pavement, $20 each; eight 6-in. hub valves, $12.25 each; one 4-in., $7.50; laying 7,500 ft. of 6-in. pipe and 250 ft. of 4-in. pipe, all 3 ft. deep, at 10 cts. per ft.

STREET WORK.—Indianapolis, Ind.—Contracts for cement walks were let April 20 at the following prices: Massachusetts Ave., 20 ft. wide, to F. M. Snyder, at $2.78 per lin. ft.; the bids ranging from this figure to $3.48; Massachusetts Ave., 15 ft. wide, to Laakman & Sherer, at $2.05 per lin. ft.; bids ranging to $2.65. The following contracts for keeping in repair vulcanite streets for one year, which streets are now about 5½ years old, were let April 27: Pennsylvania St., 42 ft. wide, was let at 30 cts. per lin. ft. each side, this being equivalent to 10 cts. per sq. yd., to the Western Paving & Supply Co., whose guaranty on the street expired last fall. The company bid $2.95 per sq. yd. under a second specification asking for bids in that form. Court St., 20 ft. wide, was let to the same company at $2.95 per sq. yd., payment to be made for the actual square yards relaid. If the asphalt surface only is renewed the price is $1.98. The Indiana Bermudez Co. bid 33 cts. per lin. ft. of each side of Pennsylvania St., and $3 and $2 per sq. yd. of pavement and per sq. yd. of asphalt surface on the same specifications as the above.

BIDS RECEIVED APRIL 11, 1895, FOR CONSTRUCTING THE WEST BLUFF SEWER SYSTEM, PEORIA, ILL.

Quantities.	James Deal & Co., Peoria, Ill.	T. B. Townsend & Co., Zanesville, O.	Wilson & Jackson, Chicago, Ill.	Geo. S. Miller & Co., Ottawa, Ill.	Penney-Meyers Const'n Co., St. Louis, Mo.	F. W. Kilner & Sons, Terre Haute, Ind.	Campbell, Dennis & Co., Joliet, Ill.	Potts-Rambrick Const'n Co., St. Louis, Mo.	Wilson & Strack, Cincinnati, O.	J. W. Gawne, Cleveland, O.	Shailer & Schniglau, Chicago, Ill.	J. Roche & Co., Chicago, Ill.	V. P. Reichert & Co., Racine, Wis.	Rockford Const'n Co., Rockford, Ill.	Jas. Cape & Sons, Racine, Wis.	Mason, Hoge & Co., Romeo, Ill.	Grants, Kinnear & Co., Columbus, O.
Trenching for brick sewers:																	
Under 8 ft. ..... 490 ft.	$0.60	$0.222	$0.23	$0.43	$0.19¼	$0.30	$0.24	$0.25	$0.25	$0.80	$0.25	$0.45	$0.60	$0.65	$0.50	$0.42	$0.39
8 to 10 " ..... 3,730 "	.44	.266	.27	.52	.30	.35	.34	.45	.45	.55	.35	.49	.60	.95	.65	.49	.45
10 " 12 " ..... 11,655 "	.40	.488	.36	.64	.40	.50	.53	.57	.66	.60	.45	.59	.60	1.00	.80	.61	.66
12 " 14 " ..... 9,080 "	.50	.70	.49	.96	.75	.85	.64	.88	.92	.90	.90	.92	.60	1.20	.65	.88	1.00
14 " 16 " ..... 8,040 "	.67	.92	.66	1.26	.83	1.10	.86	1.03	1.05	.95	.95	1.00	1.20	1.45	1.25	1.01	1.20
16 " 18 " ..... 7,664 "	1.12	1.34	.77	1.00	1.10	1.80	1.20	1.45	2.25	1.40	1.65	1.52	1.20	1.80	1.10	1.67	2.00
18 " 20 " ..... 1,975 "	1.00	1.53	1.15	1.73	1.25	1.60	2.14	1.89	2.72	1.70	2.05	1.70	1.20	2.30	1.30	1.90	2.33
20 " 24 " ..... 5,175 "	1.75	2.10	2.80	1.92	1.66	3.00	2.50	2.60	4.50	2.60	3.25	2.10	2.40	3.20	2.50	2.54	3.00
24 " 30 " ..... 4,425 "	2.00	3.835	2.80	2.28	2.57	6.00	5.42	4.80	5.25	5.00	6.90	3.35	6.00	4.55	6.00	3.36	4.28
30 " 36 " ..... 1,822 "	2.75	5.43	2.80	2.76	3.58	8.00	7.90	7.00	7.00	6.80	11.50	7.38	10.00	6.00	11.00	5.56	8.72
36 " 42 " ..... 1,410 "	2.85	6.765	2.80	3.17	4.31	8.00	10.82	8.00	8.00	10.50	11.50	9.45	12.00	8.80	11.00	6.91	8.08
42 " 48 " ..... 1,330 "	3.00	9.39	2.80	3.65	5.14	8.00	13.73	12.75	9.00	11.50	12.50	10.00	12.00	9.00	12.00	8.31	8.08
Trenching for pipe sewers:																	
Under 8 ft. ..... 7,970 "	.22	.205	.12	.22	.11	.18	.22	.15	.17	.20	.15	.20	.25	.28	.30	.26	.21
8 to 10 " ..... 43,952 "	.24	.272	.15	.28	.17	.25	.27	.18	.22	.25	.20	.27	.30	.29	.30	.31	.30
10 " 12 " ..... 36,195 "	.28	.34	.24	.38	.20	.35	.36	.23	.35	.40	.27	.38	.40	.32	.35	.32	.50
12 " 14 " ..... 18,850 "	.30	.55	.30	.46	.25	.40	.45	.30	.55	.45	.40	.47	.60	.40	.80	.49	.70
14 " 16 " ..... 6,565 "	.35	.76	.36	.59	.28	.50	.60	.30	.70	.60	.60	.57	1.00	.62	1.00	.61	1.00
16 " 18 " ..... 730 "	.41	.98	.60	.68	.31	.65	.72	.75	.88	.70	.80	.75	1.00	.82	1.50	.91	1.40
18 " 20 " ..... 1,600 "	.45	1.04	.80	.78	.36	.80	.78	.80	1.00	.90	.95	.96	1.50	.90	1.50	1.04	1.80
20 " 24 " ..... 130 "	.60	2.52	.85	1.25	.41	.90	.90	1.10	1.25	1.20	1.30	1.00	3.00	1.05	2.00	1.43	2.50
Egg-shaped brick sewers:																	
1 ft. 6 ins. x 2 ft. 3 ins... 5,040 "	.65	.83	.80	.65	.86	.50	.53	.58	.56	.75	.60	1.15	.80	.42	.55	1.06	.64
1 " 8 " x 2 " 6 " ... 6,235 "	.67	.88	.90	.74	.95	.57	.59	.62	.61	.78	.70	1.30	.50	.18	.55	1.09	.68
1 " 10 " x 2 " 9 " ... 8,545 "	.69	.94	.95	.80	1.02	.64	.65	.70	.68	.86	.70	1.44	.50	.85	.55	1.19	.75
2 " 0 " x 3 " 0 " ... 5,575 "	.72	.99	1.05	.88	1.23	.73	.71	.77	.75	.93	.75	1.51	1.00	.90	1.00	1.22	.79
2 " 2 " x 3 " 3 " ... 1,530 "	1.10	1.26	1.45	1.44	1.58	1.14	1.09	1.03	1.20	1.24	1.10	1.98	1.00	1.20	1.00	1.51	1.19
2 " 4 " x 3 " 6 " ... 2,620 "	1.20	1.40	1.55	1.55	1.68	1.26	1.16	1.10	1.30	1.40	1.15	2.08	1.00	1.30	1.00	1.58	1.27
2 " 6 " x 3 " 9 " ... 2,420 "	1.20	1.48	1.65	1.64	1.80	1.36	1.25	1.15	1.38	1.52	1.25	2.30	1.00	1.45	1.00	1.63	1.35
2 " 8 " x 4 " 0 " ... 3,235 "	2.00	2.02	2.45	2.46	2.87	2.02	2.11	1.90	2.10	2.40	2.20	2.93	2.00	2.15	2.50	2.40	2.30
2 " 10 " x 4 " 3 " ... 705 "	2.10	2.14	2.60	2.58	3.02	2.08	2.24	2.00	2.16	2.50	2.30	3.73	2.00	2.25	2.50	2.54	2.45
42-in. circular brick sewer.... 2,945 "	2.15	2.06	2.55	2.30	3.12	2.14	1.99	2.15	2.16	2.45	2.25	2.27	2.00	2.35	2.00	2.46	2.26
44-in. " " " ..... 545 "	2.20	2.22	2.70	2.42	3.27	2.23	2.09	2.20	2.30	2.58	2.30	2.30	2.00	2.40	2.00	2.54	2.26
46-in. " " " ..... 1,455 "	2.30	2.28	2.75	2.50	3.38	2.31	2.17	2.35	2.38	2.69	2.40	2.33	2.50	2.45	2.00	2.62	2.45
48-in. " " " ..... 175 "	2.45	2.39	2.80	2.65	3.50	2.38	2.27	2.40	2.46	2.75	2.50	2.59	2.50	2.55	2.00	2.70	2.55
50-in. " " " ..... 2,680 "	2.50	2.47	2.90	2.70	3.60	2.48	2.36	2.50	2.54	2.85	2.60	2.62	3.00	2.60	2.00	2.78	2.64
52-in. " " " ..... 1,380 "	2.60	2.55	3.00	2.82	3.75	2.56	2.46	2.60	2.63	2.94	2.70	2.64	3.00	2.73	2.00	2.87	2.74
54-in. " " " ..... 2,000 "	2.70	2.71	3.25	3.00	3.97	2.66	2.65	2.75	2.74	3.20	2.90	2.67	3.00	2.95	2.00	3.02	3.30
56-in. " " " ..... 805 "	2.80	2.74	3.30	3.10	4.06	2.76	2.75	2.80	2.88	3.25	3.00	2.70	3.50	3.10	2.00	3.02	3.05
58-in. " " " ..... 1,400 "	2.80	2.89	3.45	3.24	4.22	2.90	2.85	2.90	3.02	3.38	3.05	3.12	3.50	3.25	2.00	3.19	3.74
60-in. " " " ..... 990 "	3.00	3.06	3.75	3.50	4.45	3.13	3.02	3.05	3.32	3.56	3.20	3.18	4.00	3.55	2.00	3.34	3.96
64-in. " " " ..... 770 "	5.00	4.96	5.85	5.75	7.00	4.92	5.20	5.10	5.45	5.55	5.25	5.44	6.00	5.40	5.00	5.20	6.75
68-in. " " " ..... 1,770 "	5.25	5.20	6.05	6.00	7.22	5.15	5.34	5.20	5.57	5.65	5.40	5.44	6.00	5.60	5.00	5.32	5.91
70-in. " " " ..... 1,490 "	5.50	5.30	6.25	6.10	7.39	5.24	5.47	5.35	5.58	5.81	5.60	5.46	7.00	5.80	5.00	5.44	6.08
72-in. " " " ..... 1,450 "	6.50	6.08	7.00	6.93	8.55	5.96	6.34	6.05	6.49	6.63	6.45	8.90	7.50	6.70	8.00	6.17	7.09
84-in. " " " ..... 236 "	6.50	6.15	7.25	7.20	8.68	5.97	6.48	6.20	6.65	6.75	6.55	8.90	8.00	6.80	8.00	6.29	8.26
86-in. " " " ..... 706 "	6.75	6.38	7.30	7.30	8.87	6.19	6.62	6.35	6.84	6.90	6.75	8.95	8.00	6.95	8.00	6.41	8.41
20-in. pipe sewer ..... 13,275 "	.70	.622	.95	.78	.85	.57	.64	.70	.63	.63	.80	.78	.60	.70	.70	.79	.80
18-in. " " ..... 6,402 "	.50	.45	.80	.54	.61	.50	.46	.53	.52	.54	.45	.592	.45	.55	.50	.70	.42
16-in. " " ..... 7,915 "	.42	.444	.60	.48	.49	.40	.33	.44	.43	.44	.37	.482	.35	.45	.50	.57	.37
14-in. " " ..... 9,985 "	.35	.305	.50	.33	.38	.32	.29	.33	.35	.33	.30	.40	.27	.40	.50	.55	.30
12-in. " " ..... 18,335 "	.28	.233	.45	.24	.29	.26	.21	.29	.28	.27	.24	.30	.20	.32	.30	.52	.25
10-in. " " ..... 330 "	.22	.200	.35	.20	.25	.22	.20	.23	.22	.22	.18	.25	.15	.27	.30	.50	.22
8-in. " " ..... 59,670 "	.17	.1275	.27	.16	.17	.15	.11	.15	.15	.15	.125	.1575	.125	.21	.20	.45	.14
4-in. " " ..... 63,800 "	.06	.035	.10	.05	.04	.05	.04	.08	.06½	.04	.03	.065	.03	.06	.03	.04	.06
Miscellaneous:																	
¾-in. iron pipe, ... 6,000 "	.15	.122	.08	.12	.13	.10	.08	.05	.10	.15	.15	.10	.20	.08	.25	.13	.20
Manholes, pipe sewers..... 245...	20.00	28.86	30.00	33.00	35.00	25.00	25.00	44.00	25.00	34.00	30.00	33.00	30.00	30.00	40.00	45.00	40.00
Excess depth ..... 500 ft.	3.00	2.39	2.90	2.25	2.00	1.60	1.00	2.75	2.00	2.25	2.00	2.00	1.50	2.75	1.00	3.75	2.00
Manholes, brick sewers .... 150...	27.00	22.53	29.00	34.00	27.00	22.00	25.00	36.00	21.00	25.00	25.00	31.00	25.00	25.00	20.00	35.00	30.00
Excess depth ..... 600 ft.	3.50	1.94	2.90	2.25	2.00	1.50	1.00	2.75	2.00	2.00	3.00	2.00	1.50	2.80	1.00	2.00	2.00
Flushtanks, 4½ ft. diam... 54...	37.00	30.00	40.00	50.00	34.00	40.00	37.00	35.00	30.00	40.00	53.00	38.00	30.00	35.00	35.00	55.00	40.00
" 4 ft. diameter.. 131...	35.00	28.86	40.00	48.00	31.00	38.00	35.00	33.00	28.00	38.00	48.00	33.00	30.00	33.00	35.00	55.00	40.00
F. T. siphons, 8 ins. diam. 54...	25.00	27.75	30.00	18.00	35.00	25.00	25.00	30.00	25.00	25.00	27.00	24.50	25.00	30.00	25.00	30.00	30.00
" " " 6 ins. " 131...	25.00	24.42	18.50	16.00	25.00	15.00	15.00	20.00	15.00	15.00	16.50	14.75	16.00	23.00	15.00	20.00	20.00
* Comb. M. H. and F. T... 25...	10.00	1.11	10.00	3.00	12.00	10.00	11.00	15.00	10.00	11.00	10.00	35.00	1.00	3.00	1.00	10.00	20.00
Lampholes, ... 30...	13.00	4.77	6.10	2.75	5.00	5.00	5.00	6.00	3.50	5.00	4.00	5.00	8.00	6.00	3.00	5.00	30.00
Excess depth ..... 80 ft.	1.00	.11	.90	.10	.15	.20	.11	.15	.10	.20	.40	.15	.50	.20	1.00	.25	5.00
Stormwater inlets ..... 350...	50.00	16.10	37.50	24.00	21.00	10.00	17.00	29.00	20.00	22.00	22.00	10.50	10.00	25.00	30.00	35.00	.20
Excavation .....cu. yds. 25...	.75	1.11	.29	1.00	.30	1.00	.50	.50	1.00	1.00	1.00	.35	1.00	.50	1.00	1.00	90.00
Embankment ..... " " 10...	1.00	2.22	.29	.50	.50	.50	.25	.10	.50	.10	.40	.40	1.00	.50	1.00	.40	1.00
Concrete ..... " " 4...	4.00	7.77	3.95	4.50	8.00	5.00	3.00	5.50	4.00	8.00	6.00	6.00	5.00	5.00	3.50	6.50	.40
Abutment masonry, " " 46...	6.00	6.66	9.00	5.50	8.00	8.00	5.00	6.00	6.00	10.00	10.00	8.50	10.00	7.00	7.00	10.00	10.00
Rubble masonry..... " " 4...	6.00	13.32	9.00	6.00	6.00	6.00	4.00	4.00	5.00	12.00	6.00	7.00	5.00	10.00	7.00	6.00	12.00
Lumber, ... 1 M. ft.	27.00	25.00	.19	20.00	25.00	20.00	15.00	20.00	25.00	40.00	25.00	16.50	25.00	30.00	15.00	20.00	8.00
Total	$277,006	$311,139	$315,142	$316,098	$319,025	$320,490	$321,459	$324,014	$341,163	$348,712	$352,528	$357,256	$366,823	$368,378	$376,880	$377,247	$377,196

25.00

* Price to be deducted from sum of bids for manholes in pipe sewers, 4½-ft. flushtanks, and 8-in. flushtank siphons.
Thickness of walls of egg-shaped sewers: 1 ft. 6 ins. x 2 ft. 3 ins. to 2 ft. x 3 ft., 4 ins.; 2 ft. 2 ins. x 3 ft. 3 ins. to 2 ft. 6 ins. x 3 ft. 9 ins., 6 ins. up to springing line, crown 4 ins.; 2 ft. 8 ins. x 4 ft. to 2 ft. 10 ins. x 4 ft. 3 ins., 8-in. wall throughout. Circular brick sewers, 42 ins. to 66 ins., 8 ins.; 68 ins. to 88 ins., 12-in. walls.
Total assessment, $386,308. Engineer's estimate, $371,450.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

DOCK WORK.—Jersey City, N. J.—Bids are asked until May 6 for repairing and extending Morgan St. dock. Geo. T. Bouton, Clk. Comrs.

DREDGING.—Toronto, Ont.—Bids are asked until May 6 for dredging in the harbor during the present year. Morgan Baldwin, Harbor Master.

CARS, ETC.—San Francisco, Cal.—The San Francisco & San Joaquin Valley Ry. Co. is reported as receiving bids for locomotives, freight cars, etc.

DIKE WORK.—Portland, Ore.—Bids are asked until May 18 for constructing a pile and brush dike at Everett, Wash. Capt. Thos. W. Symons, U. S. Engr. Office.

COAL DOCKS.—Manitowoc, Wis.—The Chicago & Northwestern Ry. Co. is reported as to build extensive coal docks and a large elevator at this place this summer.

WHARF.—Ottawa, Ont.—Bids are asked until May 10 for the construction of a public wharf at Gardner's Creek, St. John county, N. B. E. F. E. Roy, Secy. Dept. Pub. Wks.

STONE.—Cleveland, O.—Bids are asked until May 7 for furnishing 300 cords of riprap stone at Horseshoe Reef light station, N. Y. Lieut-Col. Jared A. Smith, U. S. Lighthouse Engr.

DITCH WORK.—Albany, N. Y.—The governor has signed a bill appropriating $30,000 for widening, deepening and cleaning out of the state ditch in the Cowassion swamp, in Madison county.

RAILWAY SHOPS.—Huntington, W. Va.—Press reports state that the Ohio River R. R. Co. is about to construct new shops and a round house at this place. Gen. Man., Geo. H. Burt, Parkersburg, W. Va.

BRICK WALL.—Brooklyn, N. Y.—Bids are asked until May 14 for constructing a boundary brick wall at the Brooklyn navy yard. Address E. O. Matthews, Ch. of Bureau Yards and Docks, Washington, D. C.

HARBOR IMPROVEMENT.—Mexico, Mex.—A press report from this city states that Pearson & Sons, well-known English contractors, signed a contract April 27 for the improvement of Vera Cruz harbor, at a cost of $17,000,000.

MACHINE TOOLS.—Watertown, Mass.—Bids are asked until May 29 for furnishing 1 open-side extension planer, 1 radial drilling machine, and 1 20-ton traveling crane at the Watertown arsenal. Maj. J. W. Reilly, Ord. Dept., U. S. A.

DAMS AND SHORE PROTECTIONS.—Rock Island, Ill.—Bids are asked until May 27 for constructing dams and shore protections on Upper Mississippi River, as stated in our advertising columns. Lieut.-Col. A. Mackenzie, U. S. Engr. Office.

BOILER AND ENGINE.—Tompkinsville, N. Y.—Bids are asked until May 14 for furnishing and installing a new boiler and engine, on lighthouse tender "Rose," as stated in our advertising columns. Lieut.-Col. Peter C. Hains, U. S. Lighthouse Engr.

CONSTRUCTION.—Washington, D. C.—Bids are asked until May 14 for constructing entrance, roadway, gates, steel floating gate of caisson for dry dock, etc., at the Brooklyn navy yard. E. O. Mathews, Ch. of Bureau of Yards and Docks.

TELEPHONE FRANCHISES.—Eau Claire, Wis.—Press reports state that Huddleston & Woodin, of Chicago, have been granted franchises for telephone exchanges at this place and Chippewa Falls, and that as soon as one is secured at Menomonie the construction will be commenced.

COMPLETING DRY DOCK.—Brooklyn, N. Y.—The following bids were received by the navy department at Washington April 29 for completing the dry dock at the Brooklyn navy yard: Simpson Dry Dock Co., New York, $464,566; J. B. Westerbrook, New York, $409,988; Colin McLean, New York, $377,000; Thomas and August Walsh, New York (awarded contract), $370,000.

CARS AND LOCOMOTIVES.—St. Louis, Mo.—The Missouri, Kansas & Texas Ry. Co. is reported to have awarded a contract for 500 coal cars and several hundred furniture cars to the Madison Car Co., and it is stated that additional contracts will be awarded this week, and that a contract will soon be awarded for 27 locomotives.

JETTY WORK.—Velasco, Tex.—A press report states that there have been 397 cars of rock placed on the Velasco jetties. The contractors are pushing the work as rapidly as possible while the fine weather continues. Major Ripley has established his headquarters at Velasco, where he can supervise the construction of the jetties.

GALVESTON JETTIES.—Galveston, Tex.—A press report states that a contract has been closed by the contractors for the jetty works with the International & Great Northern Ry. Co. for the transportation of 10,000 cars of rock from the newly opened quarry in Walker county to Galveston to be used in the jetties. The contractors estimate that it will require 40,000 carloads of material to complete this contract with the government.

INDUSTRIAL NOTES.

THE GILSONITE ASPHALTUM CO., of St. Louis, Mo., is interested in the development of asphalt deposits in the Indian Territory.

THE ATLAS ENGINE WORKS, of Indianapolis, Ind., has been acquired by H. M. Hanna, who formerly held a half-interest in the concern.

J. H. DOUSMAN, of Milwaukee, Wis., has an order for a 16-lb. pressure retaining valve for the stand-pipe of the Cataract Construction Co., of Niagara Falls, N. Y.

THE UNION BRIDGE CO., of Buffalo, N. Y., has an order for 16 iron bridges for the Baltimore & Ohio Southwestern R. R. The cost will aggregate about $180,000.

THE GENERAL ELECTRIC CO., of New York, N. Y., is said to contemplate consolidating its various manufacturing plants in one large plant at Buffalo, N. Y., or Cleveland, O.

THE HOGAN BOILER CO., of Middletown, N. Y., has been reorganized, retaining its former name; capital stock, $300,000. Pres., W. D. Stratton; Vice-Pres., George M. Clemson; Secy., S. S. Mallett.

THE MONMOUTH MINING & MFG. CO., of Monmouth, Ill., has recently shipped about 50 carloads of 8 to 18-in. sewer pipe to Quincy, Ill. It reports an increased demand for its goods, and states that it is shipping about 100 carloads per month.

THE DETROIT DRY DOCK CO., of Detroit, Mich., has a contract for a sidewheel steamer for the Cleveland & Buffalo Transit Co. The vessel will be 308 ft. long, 40 ft. 6 ins. beam and 17 ft. deep, with a hull of open-hearth steel, and compound walking beam engines.

WILLIAMS, DAUGHERTY & UPHAM, of Duluth, Minn., are beginning work on their government contracts for dredging, etc., at Houghton, Mich.; St. Louis Bay, and Grasse Point, about 25,000 to 30,000 cu. yds. of dredging; and will begin work at Grand Marais, Minn., 12,000 cu. yds. of dredging, about June 1.

THE LAIDLAW-DUNN-GORDON CO., of Cincinnati, O., has recently taken a number of water-works contracts, including the following: Portsmouth, O.; Shelbyville, Tenn.; Edwardsville, Ill.; Hopkinsville, Ky.; Mount Sterling, Ky.; Perry, Okla.; Long Prairie, Wis.; Sparta, Wis.; Celina, O.; Port Clinton, O.; Great Falls, Mont.; Kenosha, Wis., and Atchison, Kan.

THE WILSON & BAILLIE MFG. CO., of Brooklyn, N. Y., is now putting down the "Kosmocrete" pavement for the sidewalks around the new Brooklyn Station of the New York and Brooklyn Bridge, and in the women's waiting rooms of the station. It is also laying this material for the sidewalks, engine room and stable floors and basements of five fire-engine houses in Brooklyn.

C. E. LOSS, 621 Pullman Building, Chicago, now has under contract over 100 miles of electric railway. He has 26 miles of track at New Orleans, La., and is also rebuilding the St. Charles St. line in the same city. This will probably be opened for traffic about July 4. He expects to complete the Waukesha Beach line about June 1. The 46 miles now being built at Oshkosh, Wis., will extend through Kaukauna, Appleton, Neenah, Menasha, Kimberly and Little Chute. The Illinois Steel Co. will furnish the rails, and the boilers and engines will be furnished by Rankin & Fritchie, of St. Louis.

NOTICE TO CONTRACTORS.

DEPARTMENT OF CITY WORKS,
MUNICIPAL DEPARTMENT BUILDING,
BROOKLYN, N. Y., April 22, 1895.

Sealed proposals will be received at this office until Monday, May 6, 1895, at 12 m., for the following purpose:

For construction of Section 2 of the main relief sewer extension in Greene avenue; Lewis avenue to Patchen avenue; Patchen avenue, Greene avenue to Fulton street; Hancock street, Patchen avenue to Saratoga avenue; Saratoga avenue, Hancock street to Halsey street; Marion street, Saratoga avenue to Howard avenue; Sixth avenue, Flatbush avenue to Union street. Amount of deposit, $9 200; amount of surety, $85,000.

Each proposal must be accompanied by a deposit in money or by a certified check in the same amount payable to the order of the Commissioner of City Works, in the sum above specified for the improvement. Such check or amount of money to be returned to the bidder in case his bid is rejected.

Plans and specifications may be seen and forms of proposals can be procured on application at the Department of City Works. Proposals must be accompanied by an undertaking in writing, with two sureties, each of whom shall qualify as to his responsibility in the sum above mentioned, and who shall be owners of real estate in the City of Brooklyn, in their own right, in the amount of such surety and shall have held the same for at least one year prior to the time of becoming such surety, that if the contract be awarded to the party or parties proposing, they will become bound as his or their surety for its faithful performance. Proposals to be indorsed "To the Commissioner of City Works" (specifying work). The said proposals will be publicly opened and announced on the 6th day of May, 1895, at the hour of 12 o'clock m., provided that the Commissioner of City Works or his regularly appointed deputy is present. In case of the absence of both, then on the first day thereafter when either is present.

ALFRED T. WHITE,
Commissioner of City Works.

Attest:
R. M. WHITING,
Secretary. 18-1t.

NOTICE TO CONTRACTORS.

Separate sealed proposals will be received by the Board of Water Commissioners of the City of Schenectady, N. Y., until noon of May 23d, 1895, for the construction of a new supply system for the water works of said city. The work will be let in the following sections:

(a.) A complete pumping plant consisting of two vertical engines each with a capacity of six million gallons in twenty-four hours and four boilers of one hundred and ninety horse power each, including all engine and boiler foundations and boiler settings. Amount of deposit to be one thousand dollars.

(b.) The furnishing and laying of about 17,505 feet of twenty-four inch cast-iron pipe with its appurtenances. Amount of deposit to be one thousand dollars.

(c.) The construction of a collecting gallery and intake pier and the furnishing and laying of the suction pipes from them to the pumping station. Amount of deposit to be five hundred dollars.

The deposit specified for each section must be in cash or a certified check made payable to the Board of Water Commissioners of Schenectady, N. Y., and will be held by said Board as a guarantee that, in case the contract is awarded, the successful bidder will, within five days after notice of such award, execute said contract.

The plans and specifications for sections (a) and (b) are now on file; those for section (c) will be ready on and after May 9th, 1895.

Specifications can be obtained from George T. Ingersoll, Superintendent, and plans can be seen at the office of the Board at Schenectady, or at the office of The Stanwix Engineering Company, Rome, N. Y.

The Board of Water Commissioners expressly reserve the right to reject any or all bids or to accept any that, in their judgment, would be for the best interests of the City of Schenectady.

E. NOTT SCHERMERHORN,
T. LOW BARHYDT,
WALLACE E. VAN DUESEN,
Water Commissioners.

GEORGE T. INGERSOLL,
Superintendent.

GEORGE T. BRADT,
18-1t Secretary.

BUILDING PORTION OF LOCK NO. 1, Osage River, Mo. Office Missouri River Commission, 1515 Locust street, St. Louis, Mo., April 18, 1895.—Sealed proposals for building a portion of Lock No 1, Osage River, Mo., will be received here until noon, May 18, 1895, and then publicly opened. All information furnished on application. J. C. SANFORD, 1st Lt., Engrs. 16-4t

BIDS FOR IMPROVEMENT OF BLACK RIVER.

Sealed proposals will be received by the Council of the village of Lorain at the office of the village Clerk until 12 m. o'clock on Tuesday, the 6th day of May, 1895, for the improving—by dredging, widening and straightening and otherwise of Black river, within the village of Lorain, between Erie avenue drawbridge and thence up the river to the Island, according to the plans. Specifications and conditions on file in the office of L. A. Fauver, acting village engineer.

The bids must be accompanied by a bond in the sum of Five Thousand Dollars or by a certified check for said amount, as a guarantee that if the bid is accepted a contract will be entered into and the performance of it properly secured by two acceptable disinterested sureties, one of whom shall be a resident of Lorain county, otherwise the amount of said bond or check shall be forfeited to the village.

Bidders must endorse the names and address upon the outside of the envelope containing the bids.

Printed forms for bids furnished by the village Clerk are to be used. Each bid must contain the full name and address of every person interested in the same.

The Council reserves the right to reject any and all bids within a period of thirty days after the same are opened.

By order of the Council as per ordinance passed. J. B. CHAPMAN, Clerk.
17-2t

STREET PAVING, FRANKFORT, IND.

Sealed proposals will be received by the Common Council of the city of Frankfort, at the City Clerk's Office, up to twelve o'clock noon of Tuesday, the 21st day of May, 1895, for furnishing all labor and material for the construction of brick pavements on four streets, comprising about 22,000 sq. yds. of pavement consisting of one course of brick or block on 8 ins. of broken]stone concrete foundation, and about 6,300 ft. of curbing.

Proposals must be made on blanks furnished by the City Engineer, and accompanied for each contract by cash or certified check in the sum of $500, payable to the City Treasurer. The Council reserves the right to reject any or all bids.

Plans may be seen at the office of, and specifications obtained of the City Engineer.

ALONZO J. HAMMOND,
18-2t City Engineer.

PROPOSALS FOR DREDGING.—U. S. Engineer Office, Montgomery, Ala., April 15, 1895.—Sealed proposals for dredging in Apalachicola Bay, Florida, will be received here until 12 o'clock, noon, May 21, 1895, and then publicly opened. All information furnished on application. F. A. MAHAN, Major Eng'rs. 16-4t

TO BOILER AND ENGINE MAKERS.—Office of the Light-House Engineer, Third District, Tompkinsville, Staten Island, N. Y., April 27, 1895.—Proposals will be received at this office until 12 o'clock noon, on Tuesday, 14th day of May, 1895, for furnishing and installing a new boiler and engine, complete, on board of the lighthouse tender Rose, in accordance with the plans and specifications which, together with the form of bid and other information, can be obtained on application to this office. Bidders are requested to examine the tender Rose before bidding, and to state in their bids where it is desired the tender shall be placed to have the work done. The right is reserved to reject any or all bids and to waive any defects. PETER C. HAINS, Lieut.-Colonel, Corps of Engineers, U. S. A., Light-House Engineer. 18-2t

PROPOSALS FOR CONSTRUCTION OF dams and Shore Protections on Upper Mississippi River.—U. S. Engineer Office, Rock Island, Ill., April 27, 1895.—Sealed proposals will be received here until 2 p. m., May 27, 1895, and then publicly opened, for: 1. Construction of dams and shore protections between Genoa and Prairie du Chien, Wis.; 2. Construction of dams and shore protections between Dubuque and Clinton, Ia.; 3. Construction of dams and shore protections between Hamburg, Ill., and Cap au Gris, Mo.; 4. Construction of dams and shore protections between Cap au Gris, Mo., and mouth of Illinois River. All information furnished on application. 18-4t

PROPOSALS FOR ENLARGEMENT AND repair of levees between Warsaw and Quincy, Ill.—U. S. Engineer Office, Rock Island, Ill., April 12, 1895.—Sealed proposals for about 600,000 cu. yds. earthwork will be received here until 2 p. m., May 14, 1895, and then publicly opened. All information furnished on application. 16-4t

U. S. ENGINEER OFFICE, PITTSBURG, Pa., April 11, 1895.—Sealed proposals for furnishing and delivering two hundred and eighty-four cubic yards, more or less, of stone for a lock in the Allegheny River, at Pittsburg, will be received here until 12 m., May 11, 1895, and then publicly opened. Information furnished on application to R. L. HOXIE, Major Engineers. 16-3t

PROPOSALS FOR ERECTION OF MEMorial Hall. West Point, N. Y.—Office of Post Quartermaster, West Point, N. Y., April 4, 1895.—Sealed proposals in triplicate will be received at this office until noon Wednesday, May 15, 1895, for the construction of a Memorial Hall. Plans can be seen and forms and specifications obtained at this office or at the office of Messrs. McKim, Mead and White, Architects, 160 Fifth Avenue, New York City. The right is reserved to reject any and all proposals. J. B. BELLINGER, Captain and A. Q. M. U. S. Army. 15-4t

U. S. ENGINEER OFFICE, WILMINGton, N. C., April 13, 1895.—Sealed proposals will be received until 12 o'clock, noon, May 14, 1895, for furnishing and delivering 1,000 to 1,100 tons of coal. All information furnished on application. W. S. STANTON, Maj. Engrs. 16-4t